TRADITIONAL CHINESE VEGETABLE FARMING PRACTICES: AN ALTERNATIVE TO WESTERN TECHNOLOGY IN VEGETABLE FARMING IN SOUTHEAST ASIA?

BY

ALAN EDWARD BACKHURST

THESIS SUBMITTED FOR THE DEGREE OF

MASTER OF PHILOSOPHY IN GEOGRAPHY

SCHOOL OF ORIENTAL AND AFRICAN STUDIES

UNIVERSITY OF LONDON

JANUARY 1983

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ABSTRACT

TRADITIONAL CHINESE VEGETABLE FARMING PRACTICES: AN ALTERNATIVE TO WESTERN TECHNOLOGY IN VEGETABLE FARMING IN SOUTHEAST ASIA?

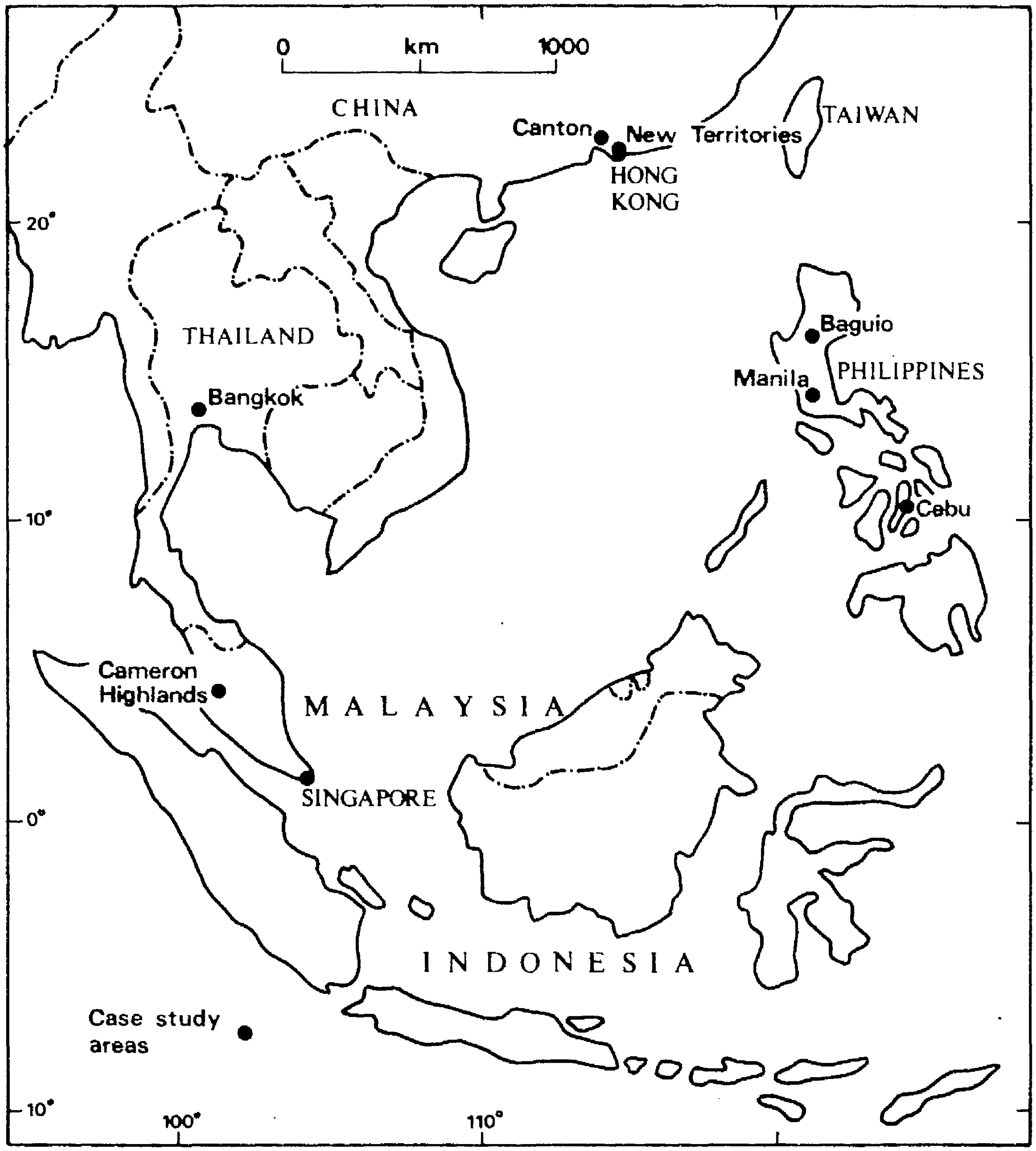
In the field of agricultural development in Southeast Asia little research has as yet been carried out on determining what possibilities exist for using the traditional practices of intensive Chinese farming systems as alternatives to modern Western agricultural technology for increasing the productivity of land. The aim of this study is to determine whether the traditional practices of the intensive vegetable farming system of South China represent practical alternatives to modern Western agricultural technology in vegetable farming in Southeast Asia.

Information was gathered on the use of Chinese vegetable farming practices in a number of different environments. Fieldwork was undertaken in eight case study areas in six countries: Canton in South China; the New Territories of Hong Kong; Bangkok in Thailand; Lim Chu Kang in Singapore; the Cameron Highlands in Malaysia; and Manila, Cebu and Baguio in the Philippines.

Analysis of the data collected shows that the use of traditional Chinese vegetable farming practices in South China is characterized by (i) high productivity of land (ii) negligible use of fossil fuel energy (iii) negligible pollution of the environment and (iv) high use of labour. It also shows that traditional Chinese vegetable farming practices have already been successfully used in a number of widely different vegetable farming environments in Southeast Asia.

Whilst the current vegetable farming practices in the case study areas involve a mixture of traditional Chinese and modern Western practices, it is demonstrated that the use of these modern Western practices has nowhere significantly increased the productivity of land over that achieved by the use of traditional Chinese practices. Moreover, the traditional Chinese practices carry with them some important, indeed critical, advantages, related to energy, pollution and labour.

The general conclusion is drawn that traditional Chinese vegetable farming practices represent practical and highly desirable alternatives to modern Western agricultural technology in helping to raise the productivity of land in a number of widely different vegetable farming environments in Southeast Asia.



Frontispiece. Locations of case study areas in South China and Southeast Asia.

ACKNOWLEDGEMENTS

Many people have generously helped me to undertake and complete this study. I am particularly grateful to my research supervisor, Professor B.W. Hodder of the School of Oriental and African Studies, for his guidance and encouragement throughout the study period.

In connection with the fieldwork, which was carried out in a number of different countries, I am indebted to many people who helped in locating relevant literature, much of it unpublished, and who arranged farm visits and kindly interpreted during those visits. Of all these people, special thanks are due to the following:

(a) China: Dean Lee Pui-man, Professor Kwan Pui-chung, Professor Lin Kung-hsun, Ms Wong Kin-kwan and Mr Chen Tso-pu of the South China Agricultural College, Canton, and local government officials concerned with vegetable production in Canton.

(b) Hong Kong: Many staff, the writer's former colleagues, of the Agriculture and Fisheries Department, especially Mr Tang, of the Land Use Unit, and Mr Y.C. Lin.

(c) Thailand: Ms Ampar Tantisira and Mr Vichan Supanish of the Agricultural Extension Department, Bangkok, and Professor Thavat Lavapaoraya of Kasetsart University, Bangkok.

(d) Singapore: Mr F. Suijkerbuijk of the University of Utrecht, visiting research postgraduate, and Dr J.W. Humphrey of the National University of Singapore at Kent Ridge.

(e) Malaysia: Mr Shukor Nurdin of the Malaysian Agricultural Research and Development Institute, Tanah Rata, Cameron Highlands.

(f) Philippines: Dr A. Palo and Mr B. Cabrera of the Bureau of Plant Industry, Los Banos and Cebu; Professor J.R. Deanon of the University of the Philippines at Los Banos, College of Agriculture; Professor E. Sano of Mountain State Agriculture College, La Trinidad; and Dr M. Potts of the International Potato Center, stationed at La Trinidad.

(g) Taiwan: Mr T. Griggs, and Dr C.G. Kuo of the Asian Vegetable Research and Development Center, and Mr K.C. Su of the Taichung District Agricultural Improvement Station.

In addition, I am grateful to the many farmers in these different countries who generously gave up time to show me around their farms and to answer questions on their farming practices. I am also grateful to personal friends in both Hong Kong and the Philippines whose hospitality I enjoyed while undertaking fieldwork in their localities.

In connection with the preparation of the thesis, I am indebted to Dr J.A. Allan and Dr H. Demaine of the School of Oriental and African Studies for their helpful comments on a number of occasions. Special thanks are due to Gina Gasson, Sammy Jane O'Brien and Sally Jane Silverman for word processing of the manuscript and to Liz Johnson for help with drawing the maps. Finally, I am very grateful to my parents for their constant moral support throughout the study period.

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CONTEXT

Conventional strategy of agricultural development planning in Southeast Asia.

In the non-communist developing countries of Southeast Asia, government agricultural departments at both national and local levels more or less follow the currently conventional strategy of agricultural development planning. This strategy, propounded for example by FAO (1970: 1-236), may be very briefly summarized as follows:

(a) The overall goal is to produce more food locally:

(i) to meet the ever-growing food requirements of rising populations, both rural and urban,

(ii) to make possible higher levels of food consumption and dietary improvements, and

(iii) to minimize the imports of foodstuffs from foreign countries and so save foreign exchange.

(b) The specific objective is to increase the productivity of agricultural land, particularly in areas where the scope for extending agricultural land is limited or where such scope exists but where government policy is not to extend the area of cultivation.

(c) The actual strategy adopted to achieve this objective, in the case of food crop production, is to intensify existing farming systems by modernizing farming practices, e.g.:

(i) by growing high yielding crop varieties and increasing cropping intensities,

(ii) by applying chemical fertilizers to maintain soil fertility under conditions of more intensive cultivation,

(iii) by applying chemical biocides (pesticides) to control weeds, pests and diseases,

(iv) by mechanizing land preparation to save time between crops, and

(v) by implementing large scale irrigation and drainage projects, to increase the efficiency of water use and control.

In other words, the strategy is the promotion of "Green Revolution" agricultural practices and, in essence, is the promotion of modern Western agricultural technology.

Productivity of agricultural land is defined, in this study, as being a measure of the quantity of food produced per unit area of agricultural land. It can be measured in terms of annual crop yield per unit area of land, in units of tonnes per hectare per year (t/ha/year).

Modern Western agricultural technology (modern Western farming practices) is defined as labour saving, capital intensive agricultural technology, based on the use of fossil fuel energy in the form of agricultural chemicals and machines. It was developed in Western Europe and North America during the nineteenth and twentieth centuries, largely as a response to the rising and high cost of farm labour, with the objective of obtaining high productivity of land with minimal use of labour. During the second half of the twentieth century, modern Western agricultural technology has been introduced and promoted in Southeast Asia.

Problems associated with the conventional strategy

The use of modern Western agricultural technology in the developing countries, including those of Southeast Asia, has resulted, undeniably, in increased crop yields and increased productivity of agricultural land in many instances. However, there are some major problems associated with the use of this technology, expounded for example by Ward and Dubos (1972: 107 and 235), Dasmann et al (1973: 153), and Richardson and Stubbs (1978: 297). These problems are particularly associated with the chemicalization and mechanization of local farming systems and may be summarized as follows:

(a) Growing dependence of poor farmers and poor food consumers on increasingly expensive fossil fuel energy, which is ultimately limited in supply, i.e., poor farmers, mainly small holders, find it increasingly difficult to buy agricultural chemicals and machines and, at the same time, poor consumers have to pay more for food produced with these fossil fuel based inputs.

(b) Pollution of the natural environment with agricultural chemicals, e.g., pollution of water courses with chemical fertilizers and pesticides, resulting in the death of fish and fish-eating predatory birds, and contamination of foodstuffs with pesticide residues, e.g., insecticides on vegetable leaves.

(c) Destruction of jobs for poor farm workers without land of their own, through the introduction of labour saving techniques, e.g., tractor cultivation, to replace hand methods. Such job destruction, added to a general lack of job creation, contributes to shortages of employment opportunities for rising rural populations, which in turn encourages poor rural people to migrate to already overcrowded cities.

Recently, the need to develop farming systems appropriate to local circumstances in developing countries in general has been recognized. The Brandt Commission Report (1980: 94), for example, stressed that, "... new models are needed for agriculture in the Third World. The western agricultural model with its high degree of mechanization and use of chemicals cannot simply be transferred to developing countries".

Towards an alternative strategy

If it can be accepted that there are important problems associated with the use of modern Western agricultural technology in Southeast Asia, and that "new models for agriculture" are needed, then the following questions arise:

(a) Is it possible that the productivity of land could be increased without the use of modern Western agricultural technology and, therefore, without incurring the associated energy, pollution and unemployment problems?

(b) Are there any traditional farming systems to be found, in any parts of Southeast Asia or in any areas outside Southeast Asia, with the necessary characteristics of:

- (i) high productivity of land,
- (ii) negligible use of fossil fuel energy,
- (iii) negligible pollution of the environment, and
- (iv) high use of labour?

(c) If such systems, possessing all of these characteristics, are to be found still in existence, or have existed in the past, is it possible that the farming practices inherent within them could be used as alternatives to modern Western farming practices?

(d) If such systems are to be found outside Southeast Asia, could their practices be used successfully in the different environments of Southeast Asia?

Need for research

As yet, little research has been done into these questions on finding alternative practices and determining whether they could be used in different Southeast Asian environments. Consequently, there is at present a lack of information, i.e., a gap in present knowledge, concerning such alternatives, and further research is needed if this gap is to be filled and the necessary information made available.

Aim of this study

The present study has been carried out in order to help fill this gap in knowledge, through an investigation of some of the possible alternatives from China. It is hoped that this investigation will provide some answers to the four questions set out above.

The specific aim of the study is to determine whether the practices of the traditional, intensive, vegetable farming system of South China represent practical alternatives to modern Western agricultural technology for increasing the productivity of land in vegetable farming in Southeast Asia.

The practices of the traditional, intensive, vegetable farming system of South China, referred to as traditional Chinese vegetable farming practices in this study, are defined as labour intensive practices used for the production of vegetables in South China over many centuries. During the last two centuries or so, these Chinese practices have been introduced into Southeast Asia by immigrant Chinese farmers and have been used there not only by immigrant Chinese but also by some indigenous farmers, the latter copying the former. It is not intended to imply by this definition that all these practices are, necessarily, of Chinese origin or invention. It is realized that certain of them might well have evolved originally in other areas outside China. However, as a group of practices used together in vegetable farming, they have been in use in South China for many centuries and as a group of practices they have been introduced into various parts of Southeast Asia, during the last two centuries or so, by immigrant Chinese farmers. Hence, for the purpose of this study, this group of practices may reasonably be called traditional Chinese vegetable farming practices. The question of whether or not certain of them, when considered on an individual basis, might have originally evolved outside China, and are therefore not Chinese in the strict sense of the word, is beyond the scope of this study. In this study, these practices are defined as traditional Chinese practices in order to contrast them with modern Western practices and also with traditional Southeast Asian practices, i.e., the labour extensive practices of traditional home gardening (mixed gardening) as described for example by Oomen and Grubben (1977: 61-65) and Terra (1954: 33-43).

Choice of focus

This study is focused on traditional Chinese vegetable farming practices, as opposed to other Chinese farming practices, for two reasons. Firstly, of all Chinese farming systems, many of which are highly productive per unit area of land, the vegetable farming systems are the most intensive (Plucknett and Beemer, 1981: 5), and therefore, their practices are possibly the most relevant to study.

Secondly, as traditional Chinese vegetable farming practices have already been transferred to a limited extent to various countries in Southeast Asia, e.g., Thailand, Malaysia, Singapore and the Philippines, the study of them provides a good opportunity to determine whether or not such practices can be successfully used in Southeast Asian environments.

Extent of previous studies

A small number of detailed studies on traditional Chinese vegetable farming practices have been carried out in the past, and contain information on the use of these practices in South China, e.g., Plucknett and Beemer (1981), and in parts of Southeast Asia, e.g., Blaut (1953) and Milsum and Grist (1941). However, none of these studies has evaluated how successfully the practices have been used in Southeast Asian environments or whether they represent alternatives to modern Western practices.

METHODOLOGY

General Approach

To achieve the aim of the study an attempt has been made to:

(a) work out the essential nature, i.e., the main characteristics of the traditional vegetable farming practices of South China, in relation to the environment where those practices were developed;

(b) show whether or not these traditional Chinese practices have been successfully used in the different environments of Southeast Asia, and

(c) assess the extent of and effects of the introduction of modern Western practices into vegetable farming in both South China and Southeast Asia.

Case Studies

At the outset of the study it was soon realized that it would not be possible to study in any detail all the vegetable farming areas of South China nor indeed of Southeast Asia, where traditional Chinese vegetable farming practices were known to be or thought to be in use. It would only be possible, with the limited time and funds available, to select a small number of vegetable farming areas as a reasonably representative sample and then carry out detailed case studies on these selected areas.

Three basic criteria were adopted for the selection of vegetable farming areas for case study, as follows:

(a) the areas should be relatively important vegetable farming areas, i.e., reasonably large, where at least some traditional Chinese vegetable farming practices were known to be or thought to be in use, such vegetable farming areas being identified from a review of previously published literature;

(b) the areas should represent a range of the different environments, both physical and human, found in the vegetable farming areas of South China and Southeast Asia;

(c) the areas should be reasonably accessible for field work.

Selection of areas

As the provinces of Kwangtung (Guangdong) and Fukien (Fujian) in South China are the principal areas of origin of the vast majority of immigrant Chinese vegetable farmers in Southeast Asia, it was considered essential to study vegetable farming practices in some selected locations in these provinces, in order to obtain a clear understanding of the nature of traditional Chinese vegetable farming practices in the environments where the practices were developed. Kwangtung Province is the place of origin of the Cantonese vegetable farmers in Southeast Asia, many of whom orginate from farming areas near to the city of Canton (Guangzhou), the provincial capital. Kwangtung Province is also the place of origin of the Teochiu (Chiuchau) vegetable farmers in Southeast Asia. These farmers originate from Swatow in the eastern part of the Province. Fukien Province is the place of origin of the Hokkien vegetable farmers in Southeast Asia.

In the event, it was only possible for the writer to obtain a visa to visit Canton for fieldwork purposes. It was not possible for the writer to obtain a visa to visit any other parts of South China, so no visit could be made to Swatow, nor to Fukien. Hence, the study of vegetable farming practices in South China was limited to locations around the city of Canton. These locations, though, which are mainly in the low-lying poorly drained parts of the Pearl River delta, produce a large quantity of fresh vegetables for the local market and also for export to the distant Hong Kong market. Because it was not possible to study vegetable farming practices in Swatow and Fukien, it was decided to include a study of the practices in Hong Kong, in order to obtain supplementary data on the use of traditional Chinese practices in a Chinese environment.

In applying the criteria for the selection of vegetable farming areas for case study to Southeast Asia, it was soon realized that it would only be possible to undertake fieldwork in Thailand, Malaysia, Singapore, Indonesia and the Philippines. For reasons of restrictions on travelling, it would be impossible to do so in Vietnam, Laos and Cambodia and difficult to do so in Burma. Because of the limitations on time and funds available for fieldwork it was decided to concentrate on a small number of vegetable farming areas, as follows:

(a) in Thailand, on the lowland poorly drained delta area around Bangkok, the capital city;

(b) in Singapore, on the lowland but well drained areas at Lim Chu Kang, located in the northwestern part of Singapore Island;

(c) in the Philippines, on a range of both lowland and highland well drained areas around the cities of Manila, Cebu and Baguio, with a range of nearby and distant markets.

However, during the early stages of fieldwork, an opportunity also arose to include a brief visit to the Cameron Highlands in Malaysia, this location being a highland well drained vegetable farming area distant from a market. Unfortunately, in the time available, it was not possible to include visits to the lowland vegetable farming areas around the capital cities of Kuala Lumpur in Malaysia and Jakarta in Indonesia.

Nevertheless, it is felt that the actual areas visited and studied are reasonably representative of the different vegetable farming areas in South China and Southeast Asia, where some traditional Chinese vegetable farming practices are currently in use. The areas studied do represent a range of the different physical and human environments found in the vegetable farming areas of South China and Southeast Asia. In addition to these areas selected for fieldwork, a visit was also made to Taiwan to gather supplementary information on traditional Chinese vegetable farming practices, particularly from the Asian Vegetable Research and Development Center.

Sources of Information

Information has been gathered on the environments, both physical and human, and on the current vegetable farming practices of all the areas selected for case study. Several sources of information have been used in the gathering of this information, as follows:

(a) published and unpublished literature available in the United Kingdom and in the countries visited for fieldwork;

(b) interviews with vegetable farmers in the countries visited;

(c) personal observation of farming practices in the farmers' fields and the recording of these practices photographically; and

(d) discussions with local agricultural officials and research workers in the countries visited.

An initial review of published literature facilitated selection of potentially suitable areas for case study, although the final selection of areas for case study was made during the course of fieldwork, after the potentially suitable areas had been visited and checked. The main review of literature has been made during the course of and after the completion of fieldwork, as a substantial amount of the literature reviewed was obtained in the countries visited during the actual course of fieldwork.

Several different types of literature have been reviewed including firstly, books and published papers, some of which were published prior to the wide-scale introduction of modern Western agricultural practices into South China and Southeast Asia, but most of which were more recently published. Secondly, a number of unpublished papers have been reviewed including government-produced mimeographed material and also academic theses at doctoral, master's and bachelor's degree levels.

The reviews of particular pieces of literature are included in this thesis in the relevant chapters, rather than as an initial body of information at the commencement of the thesis. Literature reviews have been presented in this way because it is considered that they will more clearly supplement and confirm, or otherwise, original data and information, obtained during the course of fieldwork, when presented in the relevant chapters.

Field work carried out in China, Hong Kong, Thailand, Singapore, and the Philippines was based on farmer interviews. These interviews were designed to reveal a general picture of vegetable farming practices, as opposed to providing random samples of farm data for statistical analysis. The format of questions asked is set out in Appendix D. The detailed information obtained from the interviews is set out and discussed in the relevant chapters. In Malaysia, a much simpler type of fieldwork was carried out based on personal observation of vegetable farming practices and general discussion with farmers.

The information obtained from the farmer interviews consists essentially of the farmers' answers to specific questions. Quantitative data obtained, such as fertilizer application rates and crop yields, are based on the farmers' own estimates, as it was not possible in the time available to scientifically measure the actual quantities involved. However, it is believed that this kind of data, when collected from several different farms in one location still presents a valid picture of local farming practices, despite some occasional quantitative inaccuracies which might arise. In this regard, it is requested that the reader bear in mind that the writer has had a number of years of experience in tropical agricultural advisory work and in discussing farming practices with farmers. Also, for many of the farmer interviews, skilled interpretation was provided by local experienced, English speaking, agricultural officials and research workers. These two factors, it is felt, have provided substantial checks on accepting apparently incorrect answers from farmers without confirmatory questioning and on making wrong interpretations of answers provided by farmers. Unfortunately, however, there are a few gaps in the information obtained and these have occurred for several reasons. Sometimes it was just not possible to ask all the prepared questions in a farmer interview, so that only a selection of the more important questions could, in the event, be asked. At other times a few farmers were unable or, in a very few cases, unwilling to provide answers to certain particular questions asked.

As well as carrying out farmer interviews and making personal observations of current vegetable farming practices in the countries visited, photographic records were made of the vegetable farming practices observed. In addition, some fairly lengthy discussions were held with local agricultural officials and research workers concerning the use of traditional Chinese vegetable farming practices in their localities. Information concerning these local vegetable farming practices was also gathered from local published and unpublished literature, which was kindly made available to the writer by these agriculturalists. Details of the particular agricultural and other institutions consulted are as follows:

(a) China	South China Agricultural College, Canton
(b) Hong Kong	Agriculture and Fisheries Department
	University of Hong Kong, Department of Geography and Geology
(c) Thailand	Agricultural Extension Department, Bangkok
	Kasetsart University, Department of Agriculture, Bangkok
(d) Singapore	Primary Production Department, Maxwell Road
	National University of Singapore, Department of Geography, Kent Ridge
(e) Malaysia	Malaysian Agricultural Research and Development Institute, Tanah Rata, Cameron Highlands
(f) Philippines	Bureau of Plant Industry, Los Banos and Cebu City
	Philippine Council for Agricultural and Resources Research, Los Banos
	University of the Philippines, College of Agriculture, Department of Horticulture, Los Banos

	International Rice Research Institute, Los Banos
	Mountain State Agricultural College, Baguio
(g) Taiwan	Asian Vegetable Research and Development Center, Tainan
	Taichung District Agricultural Improvement Station
	Council for Agricultural Planning and Development, Taipei
	National Taiwan University, College of Agriculture, Taipei
	Asian and Pacific Council, Food and Fertilizer Technology Center, Taipei

Period of Investigation

The overall period of fieldwork extended from August 1980 until December 1981. However, only parts of the overall time period were available for actual fieldwork, as the writer was engaged in agricultural consultancy work in Hong Kong during parts of the period and in gathering information in the United Kingdom during other parts of the period. The actual periods of time that the writer spent in each country in undertaking fieldwork, were as follows:-

(a)	China:	July 1981	2 Weeks
(b)	Hong Kong:	July 1981	2 Weeks
(c)	Thailand:	August 1980 and May 1981	2 Weeks
(d)	Singapore:	May 1981	2 Weeks
(e)	Malaysia:	August 1980	1 Week
(f)	Philippines:	March, April and December 1981	7 Weeks
(g)	Taiwan:	February 1981	3 Weeks

Although it may seem that the total period of time spent in undertaking fieldwork in these different countries is short, it is requested that the reader bear in mind that the writer has been involved in agricultural development and advisory work in East and Southeast Asia for most of the last ten years. This work has been mainly in the field of irrigation agronomy in Hong Kong and Indonesia. The knowledge of local farming practices gained from this work has enabled the writer to undertake the fieldwork required for the present study in what may seem a relatively short period of time.

Structure of thesis

Chapters 1 and 2 are baseline case studies of vegetable farming in South China, in Canton and Hong Kong. Chapter 3 is a linking chapter concerned with the background and environments of Chinese vegetable farming in Southeast Asia. Chapters 4, 5 and 6 are case studies of the use of Chinese vegetable farming practices in Southeast Asia, in Thailand, Singapore and Malaysia, and the Philippines. Chapters 7 and 8 are analytical chapters concerned with the use of traditional Chinese and modern Western farming practices in the case study areas, following which the Conclusions are presented.

Appendix A gives details of the English, Latin and local names of the vegetable crops grown. Appendix B gives details of the conversion factors used in estimating fertilizer application rates and crop yields, from data provided in local units. Appendix C gives details of the assumptions and methodology used in estimating labour use. Appendix D sets out the format of questions asked in the farmer interviews. The Bibliography follows Appendix D.

Photographic records of vegetable farming are included at the ends of the relevant case study chapters.

CHAPTER 1 VEGETABLE FARMING IN SOUTH CHINA: A BASELINE CASE STUDY OF CANTON

INTRODUCTION

This chapter focuses on the environment and practices of vegetable farming in Canton. The aim of the chapter is to provide a baseline of information on the use of and main characteristics of traditional Chinese vegetable farming practices in the environment where they were developed. Most of the information on current practices in this chapter was obtained during the writer's fieldwork in Canton in July 1981. In the course of this fieldwork interviews were carried out with five production brigade leaders. Where available, comparable and confirmatory data from previous literature are included in this chapter, in the relevant sections.

The city of Canton is located just to the south of the Tropic of Cancer, at 23 ^{o} N and 113 ^{o} E, in the northern part of the Pearl River delta. The Pearl River flows through the centre of the city, which has an elevation of only a few metres above sea level. The 5 production brigade farms visited by the writer in July 1981 form parts of 3 different communes, which are located on the northern and southern edges of the city, as shown in Table 1.1 and Figure 1.1

Table 1.1 Locations of production brigade farms visited, Canton.

Production brigade	Commune	Location relative to city of Canton
Dengfeng	Shahe	Northern edge (near Lu Hu Lake)
Fenghe	Xinjiao	Southern edge (Henan)
Lianxing	Xinjiao	Southern edge (Henan)
Siugong	Sanyuanli	Near northern edge (near airport)
Sanyuanli	Sanyuanli	Northern edge (at Sanyuanli)

Note: Chinese names are in romanized Mandarin (Pinyin), except for "Siugong" which is romanized Cantonese.

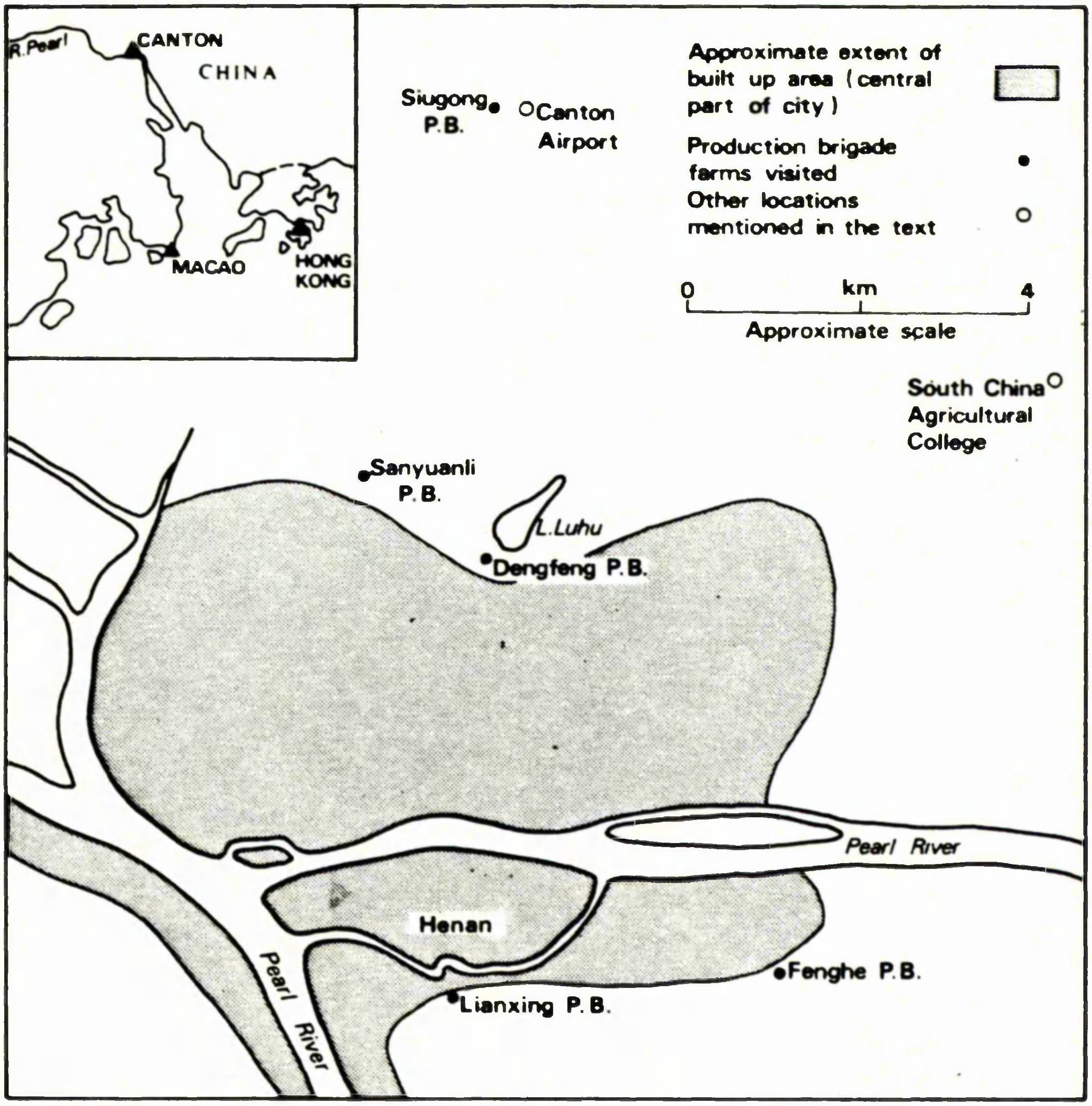


Figure 1.1 Locations of production brigade farms visited in Canton.

PHYSICAL ENVIRONMENT

Relief

The 5 production brigade farms are all located on flat, low-lying, deltaic land, except for Dengfeng, which is located on a gently sloping valley floor in the lower part of a hilly area.

Natural drainage

Overall, the Pearl River delta measures about 110 km from north to south and 90 km from east to west. It consists of a network of distributaries, but has a wide main channel, the Pearl River, on the east side, which passes through the city of Canton and empties out into the South China Sea between Macao and Hong Kong.

Much of the vegetable farm land in the Canton area of the delta has very poor natural drainage. However, this land has been made suitable for vegetable farming through the construction of dykes and drains and the pumping out of excess water from the farm land into the drains. Protection of the vegetable crops from frequent flooding is also achieved through growing the crops on the tops of high raised beds. The natural drainage of gently sloping vegetable farm land, as at Dengfeng, is good, and neither pump drainage nor high raised beds are necessary. The Pearl River at Canton is tidal, but not saline, and this facilitates gravity flow of irrigation water through some of the vegetable farming areas, when canal gates are opened at high tide.

Climate

Canton experiences a monsoon climate with distinct cool dry and warm rainy seasons. Figures for average monthly temperature and rainfall are given in Table 1.2. From these figures it can be seen that Canton has a year-round growing season. Frost, which is only experienced on higher ground (Tregear 1981: 301), is not a limiting factor.

However, heavy rainfall experienced during the summer rainy season can cause extensive damage to vegetable crops, especially those in the seedling stage. This heavy rainfall is associated both with thunderstorms and with typhoons. The typhoons, which hit South China during the latter part of the rainy season, also cause extensive damage to vegetable crops grown on trellises, which are easily blown down in the high winds. Long dry periods, occurring during the winter months, make irrigation essential for successful vegetable growing. Irrigation is also necessary on hot dry days during the summer rainy season, when vegetable farmers are often to be seen watering their crops.

This seasonality in the climate influences the kinds of vegetable crops grown at different times of the year. Different cool season and warm season crops are grown, e.g., Chinese kale in the cooler, drier, winter months and water spinach in the warmer, wetter, summer months. There are some crops, though, which are grown throughout the year, e.g., flowering white cabbage.

Table 1.2 Mean monthly temperature and rainfall, Canton.

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Mean monthly temperature, °C	13	14	17	22	27	27	28	28	27	24	19	16
Mean monthly rainfall, mm	23	48	107	173	269	269	205	219	165	86	31	23

Source: Tregear (1981: 20).

Notes : (a) Average monthly temperature is 22°C.

(b) Total annual rainfall is 1,618 mm.

Soils

Soils in the vegetable farming area around Canton are alluvial in origin. There is considerable variation, though, in soil type between the different production brigade farms. The writer's observations in the field revealed soil types ranging from sandy clay loams and silty loams in deltaic areas, to a coarse sandy loam in the gently sloping valley floor area. No very heavy clay soils were seen on any of the farms visited.

Regarding soil fertility, recently published information (Chandler, 1981: 11,15) indicates that soils in southern China, including the Canton vegetable farming area, are heavily weathered and highly leached, owing to the high temperatures and heavy rainfall. The soils are acid, with a pH between 4.0 and 5.5. They are low in fertility, deficient in phosphorus and potassium, and have a low cation exchange capacity. They require intensive management in order to grow vegetables and, in fact, receive enormous quantities of organic fertilizers in order that a soil of artificially high fertility may be developed.

McCalla and Plucknett (1981: 37) reported that although organic fertilizer applications have been high over long periods in the Canton area, the organic matter content of the soil appears to be low. This indicates high biological activity in the soil, rapid oxidation of the added organic matter, and rapid transformation of the organic materials into the inorganic nutrients of the soil, which provides the vegetables with an adequate nutrient source. They also reported that the availability of nitrogen, phosphorus and potassium is high and adequate for optimum vegetable growth.

HUMAN ENVIRONMENT

Markets

Canton is the largest city in South China and it constitutes a large urban market for fresh vegetables. Skinner (1978: 745, 764) and Wiens (1981: 286) estimated the population of the city of Canton to be 2.3 million people and the average daily supply of vegetables to the city to be 1,100 tons per day. These figures give an average daily supply of vegetables per capita of 0.48 kg. Skinner also points out (p.764) that virtually all this daily supply of vegetables is produced within the suburban districts of the municipality of Canton itself.

Visits by the writer to 5 production brigade farms in these suburban districts revealed that they are all connected by motorable farm roads to the urban road network. Harvested vegetables are transported on small trailers, pulled by single-axle "walking tractors", or sometimes on trucks, to the city's vegetable markets. Hence, it can be seen that the vegetable farms around Canton are located adjacent to a large and easily accessible urban market.

However, some of the vegetables produced on Canton's vegetable farms are exported to Hong Kong. According to information provided by the leader of Dengfeng Production Brigade, during discussions with the writer, some 10% of the vegetables produced on this brigade farm are marketed in Hong Kong. Hence, the vegetable farms around Canton have access to another large, although distant market, Hong Kong having a mainly urban population of over 5 million people and being located some 130 km southeast of Canton.

The vegetable marketing system of Canton, and the role of government in the system, has been included in detailed reports on the supply and marketing of vegetables in China by Skinner (1978: 768 and 779) and Wiens (1981: 281-282). In brief, it can be said that the supply and marketing of vegetables in the Canton Municipality is under the control of various government agencies, including the Agricultural Production Bureau, the Supply and Marketing Cooperative and its subordinate the Vegetable Company. The Vegetable Company maintains 4 local management offices and supervises 7 linking stations and 39 large retail marketing clusters in the urban districts. It also supervises vegetable receiving stations and wholesale depots in the urban areas of the suburban districts. Hence, the full extent of government control in vegetable marketing can easily be seen. In Skinner's opinion (p.779), though, this marketing system is both economic and flexible.

Some vegetables are also sold on a free market basis, by roadside vegetable vendors, who may often be seen selling vegetables near the city centre, as well as in suburban districts. However, no information was obtained on the size and relative importance of this free market.

Farming Stucture

An estimate of the overall size of the vegetable farming area around Canton has been prepared by Wiens (1981: 286). His estimate, which is based on the parameter of urban vegetable supply area under Vegetable Company management, gives a continuous vegetable area, where vegetables are grown all the year round, of 5,330 ha, and a seasonal vegetable area, where vegetables are grown during a part of the year only and other crops such as rice during the rest of the year, of 1,330 ha. The total vegetable area is, by addition of the continuous and seasonal areas, 6,660 ha.

The land making up this vegetable farming area is, of course, not privately owned, China being a communist country, but is farmed on a collective basis. The farm workers are organized into communes, production brigades and production teams. An example of this kind of organizational structure in Canton was reported by the American Plant Studies Delegation (1975: 85). The example is that of Hsinchiao (Xinjiao) Commune, which is located on the southern edge of the city of Canton, and contains 2 of the production brigade farms visited by this writer, viz., Fenghe and Lianxing. The Delegation, in 1975, reported that the commune had 58,000 people, 3,467 ha of land, 19 production brigades, with 9 growing 700 ha of vegetables, and 220 production teams.

Further information about the organizational structure of this same commune was reported by Wiens (1981: 317), who considered the example of one production team of 105 members, 70% of whom were female. At the top of the team was a committee of 6 leading members, including the team leader, two vice-leaders (in charge of vegetable production and animal husbandry, respectively), and 3 others specialized in animal husbandry, fodder supply, and sanitation and "women's life", respectively. Of the remaining team members, 11 had special responsibilities: 5 for animal feeding, 5 for management of the nursery-kindergarten, and 1 "barefoot" doctor. These 11 members did not participate in crop cultivation. 4 of the leading members of the team were in charge of the same number of work groups, consisting of some 23 members each. Each group cultivated little more than 1 ha of contiguous land, which usually remained the same from year to year. Within the group there was further division of responsibility, e.g., there were seedling workers and manure workers, and of tasks, e.g., into heavy and light work. In this organisational structure, the production brigade was seen to be one of the important levels at which the farm workers have contact with municipal authorities and technical specialists (p.318).

Not all land, though, is farmed on a collective basis, as farm workers are also allocated very small areas of farm land, e.g., 3 square metres at Siugong, for their own use as private plots. Vegetables may be grown on these private plots and either kept for home consumption or sold privately to supplement family income. Those private plots seen by the writer at Siugong were very intensively cultivated with vegetables, as can be seen in the Siugong private plot cropping pattern illustrated in Figure 1.2.

Information on production brigade farm size, vegetable area and livestock numbers was made available to the writer by the leaders of 3 of the 5 production brigades visited, viz., Dengfeng, Fenghe and Siugong. Farm sizes, i.e., total crop areas, and vegetable crop areas are 40 and 27 ha at Dengfeng, 155 and 143 ha at Fenghe, and 119 and 97 ha at Siugong, respectively. Hence, average farm size and average vegetable crop areas are 105 ha and 89 ha, respectively, for the 3 farms. Furthermore, on average, 85% of the farm area is cropped with vegetables. The remainder is used for growing other crops, e.g., rice, flowers and bamboo.

Large numbers of livestock are raised on the production brigade farms, with nearly all the livestock being intensively housed. Large herds of pigs are kept on the farms, with herds ranging in size from 3,200 at Dengfeng, 1,200 at Fenghe and 1,500 at Siugong, and averaging 1,967 for the 3 farms. By taking average figures for the 3 farms of 1,967 pigs on 105 ha of land, it can be seen that there are about 19 pigs/ha. This figure compares reasonably closely with Mao's target figure of one pig per "mou", i.e., 1/15 ha, for Chinese agriculture generally, as reported by McCalla and Plucknett (1981: 31).

Significant numbers of other kinds of livestock are also kept on the brigade farms, including dairy cattle, draught cattle, water buffalo, goats, chickens, ducks and geese. Hence, it can be seen that these production brigade farms are, essentially, mixed farms and not merely specialist vegetable farms. The livestock not only provide meat, milk and eggs, but also provide draught power and large amounts of animal manure for vegetable production.

Farm labour supply

Information on the number of families and total populations in the production brigades was made available by brigade leaders at Fenghe and Siugong. At Fenghe, there were reported to be 1,200 families and a total population of 5,600, and at Siugong, 950 families and a total population of 4,788. Hence, average family sizes in these two production brigades equate roughly to 4.7 and 5.0 persons respectively, including children and parents.

Information on the numbers of vegetable farm workers was also made available for Dengfeng, Fenghe and Siugong. There were reported to be 750 at Dengfeng, 3,000 at Fenghe and 1,600 at Siugong. At Dengfeng and Siugong these workers provided labour specifically for vegetable crops, whereas, at Fenghe they provided labour for vegetable crops together with a small area of rice and flower crops, equivalent to 8% of the vegetable area.

Estimates of the number of vegetable farm workers per hectare of vegetable land have been made by dividing the number of vegetable farm workers by the vegetable crop areas (27 and 97 ha) in the cases of Dengfeng and Siugong, and by dividing the total number of crop workers by the total vegetable, rice and flower crop areas (155 ha) in the case of Fenghe. On this basis, the numbers of workers per hectare of vegetable crop land are 27.8 at Dengfeng, 19.4 at Fenghe and approximately 16.5 at Siugong, with an average of 21.2 for the 3 farms.

In his report on the organizational structure of a production team in the Hsinchiao (Xinjiao) Commune, of which Fenghe Production Brigade is a part, Wiens (1981: 317) estimated that a typical work group of 23 workers covers little more than one hectare of contiguous vegetable land, a figure which closely resembles the figure of 19.4 vegetable workers per hectare at Fenghe estimated above. Also, Skinner (1978: 758) estimated that the ratio of full-time labour equivalents to area of continuous vegetable fields ranges from 12 to 22 persons per hectare for a number of locations throughout China. Hence, it can be concluded that the supply of labour to vegetable farming on the edges of the city of Canton is very high, at a figure of around 20 persons per hectare.

Regarding the quality of the farm labour supply, the local Cantonese vegetable farm workers possess a great wealth of experience in vegetable farming. For example, at Dengfeng it was reported that vegetable farming had been going on there for more than 100 years and at Fenghe for around 200 years.

Farm input supply

Large quantities of organic fertilizers are readily available for the production of vegetables. Pigs and other livestock kept on the production brigade farms produce substantial amounts of manure. Nightsoil, i.e., human manure, produced by the urban population, is collected and distributed to the vegetable farms by Canton's municipal fertilizer company. Extra nightsoil is available from the production brigades' own domestic housing areas. Rubbish from the urban area is also collected and distributed to the vegetable farms by the fertilizer company. Smaller quantities of other organic materials, including rice straw, weeds, ashes and poultry feathers are also available. All these organic fertilizer materials are fermented to some extent prior to field application. Details of the processes used are given later in this chapter, in the "Organic fertilizers: materials and preparation" section. A detailed study of the collecting, transporting and processing of organic fertilizers in China, for various locations including Canton, has been made by McCalla and Plucknett (1981: 19-37).

Agricultural chemicals, i.e., fertilizers and pesticides, are made available to the production brigades by the municipal authorities, although these chemicals are not in fact used in great amounts. Similarly, single-axle "walking tractors" (11 HP) and trailers are made available for transportation. For land preparation, draught animal power is available from the cattle and water buffalo kept on the brigade farms. Vegetable seed is usually produced or saved on the brigade farms and little has to be brought in from outside.

All the production brigade farms visited have adequate supplies of water for irrigation, either from river or groundwater sources or, in the case of Lianxing, from domestic waste water. Generally, these are pumped supplies. However, there is a problem of too much water in some low-lying areas and to overcome this, pumped drainage has been installed in low-lying areas prone to flooding, such as Fenghe. Both the irrigation and drainage pumps are electrically powered.

CURRENT PRACTICES

Vegetable crops grown

A wide range of leafy, fruit and root vegetable crops is grown throughout the year in the Canton area. The crops specifically mentioned by production brigade leaders during discussions with the writer are listed in Table 1.3. The vegetables most frequently seen by the writer, during visits made to production brigade farms in the latter part of July, were: flowering white cabbage, water spinach, Chinese chives, yard-long bean, oriental pickling melon and wax gourd.

Information concerning the total numbers of different vegetables grown in the Canton area has been provided by the American Plant Studies Delegation (1975: 79), which reported that 60-70 different vegetables are grown at Hsin-chiao (Xinjiao) Commune in Canton. This delegation also reported that in China generally over 100 different kinds of vegetable are grown. In this general context, Shen (1951: 219) stated that there are more kinds and varieties of vegetables in China than in any other country in the world.

Intensity of cropping

Typical cropping patterns described by brigade leaders are shown in Figure 1.2. In this sample of typical cropping patterns, the number of vegetable crops grown on the same field bed each year varies from 6-14, with an average, omitting the private plot, of 9.7 crops per bed per year. This very high intensity of cropping is achieved mainly through the continuous sequential growing of relatively short duration crops, i.e., short in duration compared to rice, and also through the use of transplanting and interplanting practices wherever and whenever possible.

Table 1.3 Vegetable crops grown, sample durations and planting methods, Canton.

Vegetable crops grown	Seed bed period, days	Trans-planting or direct sowing to first harvest, days	Harvest period, days	Total crop dur-ation, days	Duration of crop in field beds, days	Planting method
Leafy vegetables						
Flowering white cabbage	20-30	25-35	0-10	45-75	25-45	T
- " -	-	35	10	45	45	DS
Chinese white cabbage	25	30	-	55	30	T
Celery cabbage						
Chinese kale						
Leaf mustard	-	50	-	50	50	DS
Chinese spinach	20	25-30	-	45-50	25-30	T
- " -	-	30	-	30	30	DS
Lettuce						
Celery						
Water spinach	20-30	10-20	90-120	120-170	100-140	T
Watercress						
Spinach						
Garland chrysanthemum						
Chives						
Chinese chives						
Wild rice						
Fruit vegetables						
Yard-long bean	-	40-45	20-30	60-75	60-75	DS
French bean						
Sugar pea						
Cucumber	-	35	15	50	50	DS
Oriental pickling melon	-	35	20	55	55	DS
Wax gourd	-	60	30	90	90	DS
Winter squash						
Angled loofah	-	45-60	40-90	85-150	85-150	DS
Bitter cucumber						
Eggplant	-	80	40	120	120	DS
Root vegetables						
Shallots	30-60	30-35	-	60-95	30-35	T
Ginger	-	150-200	-	150-200	150-200	DS
Yam bean						
Greater yam						
Taro	-	200	-	200	200	DS

Source: Discussion with production brigade leaders, 1981.

Notes: (a) All time periods are given in days, rounded to the nearest 5 days.

(b) Planting method abbreviations: T = Transplanting;
DS = Direct sowing or planting.

(c) Both wet and dry bed forms of water spinach are grown.

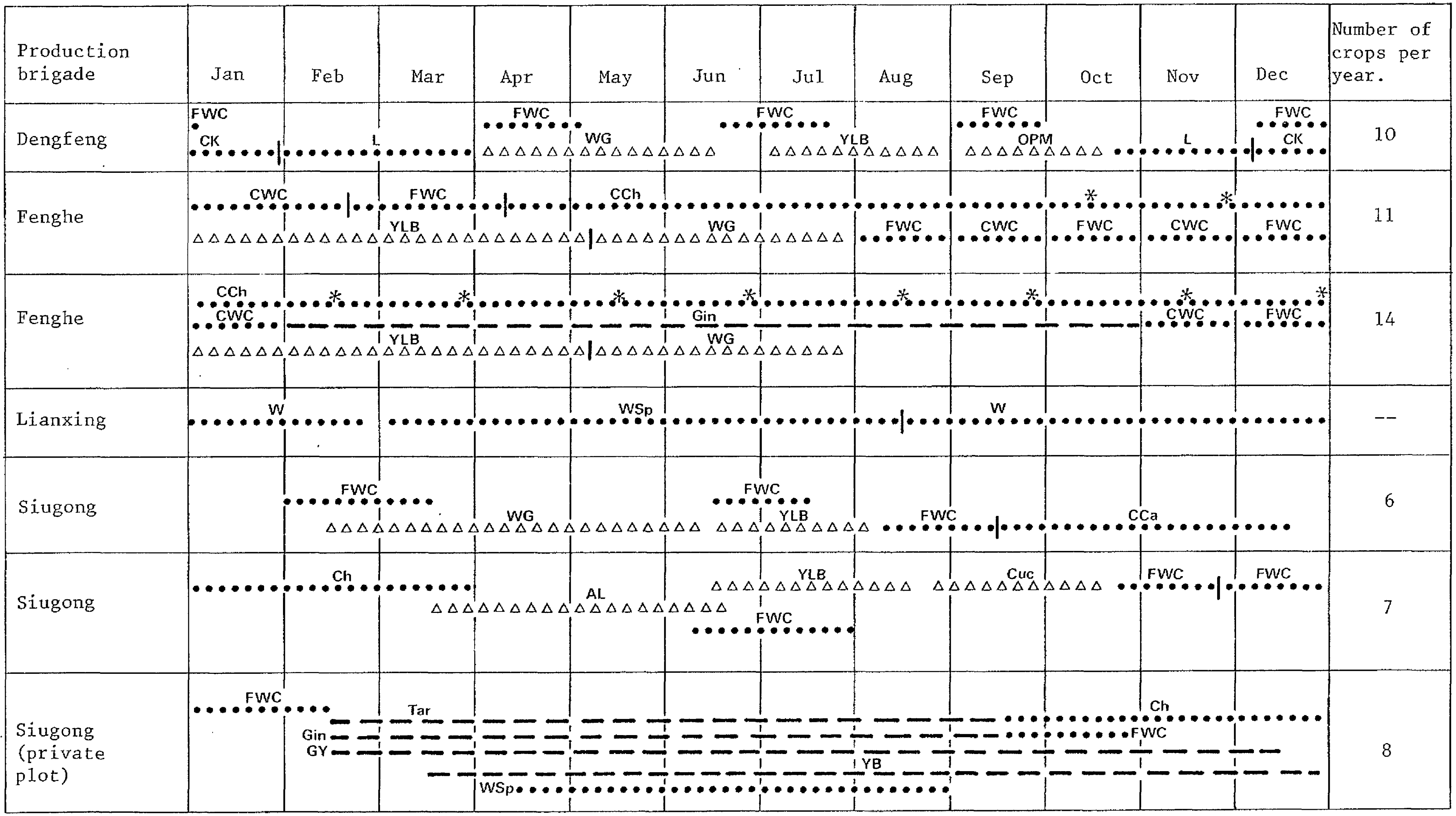


Figure 1.2. Vegetable cropping patterns, Canton.

Figure 3.2 Continued.

Source: Discussion with production brigade leaders, 1981

Notes (a) Key: Crop growing period, in field bed:

Leafy vegetable	••••
Fruit vegetable	△△△
Root vegetable	——
Harvest times of Chinese chives	*

(b) Crop name abbreviations used:

Flowering white cabbage	FWC
Chinese white cabbage	CWC
Celery cabbage	CCa
Chinese kale	CK
Lettuce	L
Water spinach	WSp
Watercress	W
Chives	Ch
Chinese chives	CCh
Yard-long beans	YLB
Cucumber	Cuc
Oriental pickling melon	OPM
Wax gourd	WG
Angled loofah	AL
Ginger	Gin
Greater yam	GY
Yam bean	YB
Taro	Tar

(c) This figure represents only a sample of the typical vegetable cropping patterns to be found in Canton.

(d) Each cropping pattern shown relates to one field bed only.

Harwood and Plucknett (1981: 46) reported similar figures for the high number of crops grown per year in the Canton area. They reported that as many as 10 or 12 crops per year are grown in the Canton area. FAO (1980: 34) reported that 6-10 crops per year are grown at Sinchiao (Xinjiao) Commune, Canton.

Crop durations

Information was obtained from brigade leaders on the durations of a sample of the different crops grown and this is set out in Table 1.3. Further information on crop durations is available from the typical cropping patterns shown in Figure 1.2. When comparing these two sets of information, some variation in crop durations may be seen. This is mainly made up of variation between production brigades, particularly when the same crops are grown in different seasons on the different brigade farms. What may at first sight appear to be discrepancies between the two sets of information in the durations of certain crops, may best be understood as representing a greater range of variation for these crops than is suggested by Table 1.3, which should be considered only as representing some typical cases.

A high number of sequentially grown short duration crops in a cropping pattern is a major factor contributing to high cropping intensity, as can be seen clearly in Figure 1.2. In general, the leafy vegetables are of short duration in the field beds, in most cases less than 60 days. Water spinach and Chinese chives are exceptions, but these crops provide a number of distinct harvests, during a long total growing period, each harvest being considered as an actual crop. Fruit vegetables are somewhat longer in the field beds, as the individual fruits do not ripen simultaneously, and harvesting has to be continued over a lengthy period. Root vegetables vary in duration, shallots being of short duration whereas taro and ginger are of long duration in the field beds.

Planting methods

Most of the leafy vegetable crops grown are transplanted, especially in the dry season. The practice of transplanting reduces the length of time that the crops require in the field beds, as the early stages of growth take place in nursery seed beds, which occupy only a very small, more or less insignificant, area of land. Hence, transplanting is another factor contributing to high cropping intensity. However, most of the fruit and root vegetables grown are directly sown or planted.

For the practice of transplanting to be successful, the crops must be able to tolerate the physiological stress that actual transplanting entails. Most of the leafy vegetables grown can tolerate this stress, except occasionally in the heavy rainfall conditions of the wet season, which may damage fragile transplanted seedlings. In this case, some of the leafy vegetables have to be directly sown in the field beds. The fruit vegetables are directly sown, as apparently they do not tolerate well the physiological stress associated with transplanting. Of the root vegetables, shallots are transplanted, whereas most of the other root vegetables are propagated vegetatively. Some other vegetables, though, are propagated vegetatively, e.g., water spinach and watercress grown under flooded field conditions, by dividing up and replanting established plants at the start of the growing season.

Interplanting

Interplanting is widely practised in the Canton vegetable farming area. It often involves planting rows of a short duration crop on the area of soil not yet covered by a longer duration crop, in the latter's early growth stage. The short duration crop is harvested before the longer duration crop develops its full leaf area. For example, rows of flowering white cabbage are often planted between rows of a trellised fruit vegetable in the latter's early growth stage.

Interplanting may also involve the planting of leafy, fruit or root vegetables between rows of a shade tolerant vegetable crop grown on a semi-perennial basis, e.g., flowering white cabbage or yard-long bean or ginger, between rows of Chinese chives. In this case, the interplanted crop may well be grown on a trellis, e.g., yard-long bean.

Vegetable crops may sometimes be relay interplanted, in which case as one crop nears completion another is planted between its rows, in order that the latter may be well established at an earlier date than would be possible if it was planted after final harvest of the former. Examples of these three types of interplanting can be seen in Figure 1.2. Interplanting, especially relay interplanting, is another factor which contributes to high cropping intensity.

The number of crops interplanted on the same bed at the same time is usually two, on the production brigade farms visited. However, 5 different crops were seen growing together in a private plot field bed at Siugong, as shown in Figure 1.2. The 5 crops were: greater yam, water spinach, ginger, yam bean and taro. Of these, greater yam and yam bean were grown on trellises.

In this study, the term interplanting has been used as opposed to the alternative term of intercropping. Following the definitions put forward by Ruthenberg (1980: 395), in which interplanting is defined as all types of seeding or planting a crop into a growing stand and intercropping is defined as the growing of two or more crops in different but proximate rows, it seems more appropriate to this writer that the term interplanting should be used in relation to vegetable farming in Canton, as it expresses the idea of planting a crop between the plants or rows of an existing crop, which is nearly always the case in Canton.

Rational close spacing

The way in which high intensity of cropping is achieved through the continuous sequential growing of short duration crops, and by transplanting and interplanting, has been summed up in the Chinese concept of "rational close spacing". This is known today as one of Chairman Mao's eight basic "characters" for agricultural modernization, and has been described by Harwood and Plucknett (1981: 45). Although the concept of rational close spacing is used today to encourage so-called agricultural modernization, the practices involved in it are well-proven, traditional practices, and are, for example, described by King (1911: 11, 263-370).

As Harwood and Plucknett (1981: 45) point out, rational close spacing means the growing of crops in patterns which are as intensive as feasible and at plant densities that will give maximum yield. The strategy is designed to give maximum productivity from limited land and water resources in a labour-intensive agricultural economy. The resulting cropping patterns are highly intensive and highly productive.

Staggering of planting dates

General observation of the brigade farms revealed that the same crops grown in different fields were at different stages of growth, viz., some had just been planted while others were being harvested on the same day. In other words, the planting dates of the same crops in different fields were staggered. However, for any one crop in any one field, it was not apparent that there was any staggering of planting dates between the different field beds; this contrasting markedly with the situation on small vegetable farms visited in other countries, e.g., in Singapore.

The purpose of staggering planting dates of a particular crop is to spread the peak labour demands of that crop over a longer period of time, than would be the case if the whole crop were planted on the same day. In addition, staggering of planting dates may help to reduce crop losses in adverse conditions, e.g., a torrential rain storm or a typhoon, as only a part of the crop is at a sensitive growth stage, e.g., seedling stage, at any one time.

Diversified cropping

General observation of the brigade farms also revealed that a range of different leafy, fruit and root vegetable crops were growing at the same time in different fields on the same farms. The only exception to this was at Lianxing, where specialized production of water spinach and water cress only takes place. Diversified cropping also helps to spread peak labour demands and reduce crop losses in adverse conditions, as different crops have different durations and hence are usually in different growth stages at any one time.

Crop rotations

Generally, crop rotation is always practised, as can be seen in the cropping patterns in Figure 1.2, and its role in pest and disease control is well-known. It is very rare that the same crop is grown in continuous succession, the only exception being interplanted flowering white cabbage.

Occasionally, a rice crop may be grown on low-lying vegetable fields at Fenghe and Siugong, for example once every 3-4 years. The rice crop is grown, according to production brigade leaders, to improve soil structure, to turn over leached top soil and to control crop pests and diseases. Chandler (1981: 16) stated that the rice crop is grown to destroy harmful insect pests by flooding and to break the cycle of diseases that may build up under continuous vegetable production.

Field and bed layouts

Field and bed layouts vary according to relief and drainage. On those production brigade farms with gently sloping land and good drainage, e.g., Dengfeng and a small part of Sanyuanli, fields are unterraced and unbunded. However, these fields do appear to have been partially levelled, as they are slightly convex in shape, being a little higher at the centre, and lower at the edges, along which run open, masonry-lined field drains. In the low-lying, poorly drained areas, which make up most of the vegetable farm land around the city of Canton, the fields are levelled and bunded, in order to facilitate water control and the drainage of excess water, e.g., Fenghe, Lianxing and Siugong.

In the gently sloping areas, on the unterraced and unbunded fields, beds are raised up, with footpaths between each bed to provide access to the crop plants and adequate drainage. When measured from centre to centre, i.e., including half of the footpath around each bed, typical bed dimensions are: width, 1.5 m, height, 0.15-0.2 m, and length, 18 m. On the basis of these dimensions, the number of beds per hectare is 370.

In the low-lying areas, on the levelled, bunded fields, beds are raised to a higher level, and instead of a footpath between each bed there is a relatively deep furrow or ditch containing water. This ditch acts as a footpath and, also, as a small canal providing access to the crop plants. Apart from walking in the ditch, the farmer floats a small wooden boat in the ditch, to carry fertilizers to the beds and harvested vegetables from the beds. However, the main function of the ditch between the high beds is to ensure adequate drainage in areas where frequent flooding is a problem. When measured from centre to centre, typical dimensions of these beds are: width, 2.0-2.5 m, height 0.5-0.6 m, and length, variable, e.g., 30-35 m at Fenghe. Typically, the width of the ditch at the top is about 1 m. The tops of the raised beds are often slightly convex in shape which helps in the drainage of excess rainwater from the surfaces of the beds.

In other levelled, bunded fields, in low-lying areas, no beds are raised up, but the fields are used as basins for the growing of aquatic crops, such as watercress and water spinach, e.g., at Lianxing and a part of Sanyuanli.

Where trellis crops, such as fruit vegetables, are grown, raised beds are often aligned on a North-South axis, in order to maximise the receipt of sunlight by the leaves of the trellis crop. It is thought, by production brigade leaders, that with this axis, morning and afternoon sunlight is intercepted evenly by the East and West faces of the trellis crop, respectively. If, on the other hand, the axis was East-West, then the North face of the trellis crop would receive less sunlight than the South face, and overall, the crop would intercept less sunlight. This would result in reduced and uneven growth. It is noted, in this respect, that the latitude of Canton is 23 ^{o} N, and therefore, the sun only passes overhead at and around the time of the summer solstice. For the rest of the year the angle of the midday sun is inclined southwards.

Cultivations

The implements used for land preparation are cattle or water buffalo drawn ploughs and, also, hoes. No tractors are used for land preparation on the farms visited.

In the fields with low raised beds, i.e., with footpaths and not ditches between them, ploughing with cattle is carried out at each change of the main crop during the summer. However, at each change of the main crop during the winter, the beds are hand dug by hoe.

In the fields with high raised beds, with ditches between them, the soil is ploughed once every 3-4 years, when a rice crop is grown. Preparing the land for the rice crop, which entails breaking down the beds and filling the ditches, is done by ploughing with cattle or water buffalo. After the rice crop, the land is ploughed again and new high beds are raised up by hand with hoes. At other times when vegetable crops are changed on these beds, the soil is hand cultivated by hoe, the ditches are cleared out, the mud from the ditches is returned to the tops of the beds and the bed edges are repaired by hand. A dressing of basal organic fertilizer is usually applied to the beds at this stage. When an intercrop is changed but the main crop remains in the bed, a light hand hoeing is carried out to remove weeds and prepare the soil surface for the new intercrop.

Mulching

Rice straw was observed being used as a mulch on vegetable seed beds on 2 brigade farms, in order to protect the seedlings from being washed away or damaged by heavy rain, to reduce weed growth, and to reduce evaporation of soil moisture in dry weather. However, production brigade leaders reported that rice straw was now in fairly short supply and they were only able to use it very sparingly. Rice straw was also observed being used as a mulch on a maturing yard-long bean crop at Dengfeng.

Apart from rice straw, other materials are used for mulching. Composted domestic rubbish, widely applied to the bed surfaces as a top dressing of organic fertilizer, also functions as a mulch. Old clothes and straw matting were seen being used as mulches at Fenghe, to protect bed edges from erosion and also from weed growth. Plastic mulches were reported to be in use on seed beds at Siugong, although these were not actually seen by the writer.

Overhead protection of seed beds

Although not actually observed on the 5 production brigade farms formally visited by the writer, protective structures, made of rice straw supported on bamboo frames, were seen covering seed beds on a production brigade farm located on the East side of Canton, beside the road leading to the South China Agricultural College. This type of structure protects vegetable seedlings from damage by heavy rainfall and provides the necessary shade during sunny weather.

Trellising

Climbing types of fruit vegetables, e.g., yard-long bean and wax gourd, are always grown on trellises in the Canton area. The trellises are constructed of bamboo stems implanted at an angle into the beds. The bamboo stems are tied together near the tops so as to form a ridge covering the footpaths or ditches between the beds. The ridge is made sufficiently high to enable the farmer to walk underneath.

Trellising provides several advantages in the growth of climbing types of vegetables. Firstly, it enables a maximum crop leaf area to develop which intercepts as much sunlight as possible and enables the crop plants to produce a greater yield of fruits than would be possible if the plants were left to sprawl over the ground, where moreover, their fruits would be more likely to rot. Secondly, trellising improves fruit quality by enabling the plants to grow in a way which protects their fruits from excessive direct sunlight. The fruits hang down on the underside of the trellis and are shaded by the leaves which are above them. Also as the fruits are suspended above the ground, they are less susceptible to pests and diseases. Because the fruits hang down on the underside of the trellis, it is easy for the farmer to inspect them, when walking along the footpath or ditch, and to pick them when they are ready for harvest. Thirdly, trellising enables the crop plants to cover the land area occupied by footpaths or ditches. This overcomes the problem of unused, or wasted, land inherent in raised bed layouts. Hence, with a trellis, the entire field area is effectively used and no land is wasted. Furthermore, where ditches are present, the farmer can transport the picked fruits in a small wooden boat pushed along the ditch. Harwood and Plucknett (1981: 51-52) reported similar advantages of trellising: higher plant densities, better fruit quality, more intercrop alternatives and less plant disease. They also reported (p.99) that the combination of trellises over ditches compensates almost completely for land lost to the drainage system.

One major disadvantage in the use of trellises is that should a typhoon hit the vegetable farming area, the damage done to the trellis crops is very extensive, as trellis work covered by a crop is easily blown down by strong gusting winds.

Clay pots for blanching Chinese chives

Small clay pots, consisting of a cylinder with a detachable lid, were seen in use at Fenghe for the blanching of Chinese chives. The blanching entails enclosing the plants inside the pots for a few weeks so that, growing in the absence of light, the leaves turn light yellow in colour. This blanching process develops a particular flavour in the leaves which is much prized in Chinese cooking.

Harwood and Plucknett (1981: 51) reported that out of 9 crops per year of Chinese chives in Canton, 4 are green chives, 4 are blanched chives and 1 is flowering chives. In this context, the 8 crops per year shown in Figure 1.2., does not represent a significant departure from 9 crops mentioned here.

Organic fertilizers: materials and preparation

Many different organic materials are used as fertilizers on the production brigade farms. These include large quantities of animal manure, nightsoil, i.e., human manure, and composted domestic rubbish, and also, smaller quantities of rice straw, weeds, ashes and poultry feathers. The supply of these materials is described earlier in this chapter, in the "Farm input supply" section.

All the organic fertilizer materials are fermented, to some extent, before they are applied to the vegetable beds. Liquid manures are fermented in tanks or sumps, whereas drier materials are composted in heaps.

At Dengfeng, liquid pig manure is pumped through a pipeline network from the pig buildings to cement lined sumps located at convenient points on the edges of the fields. It is fermented in these sumps for 5-6 days, before being applied manually to the vegetable beds.

Nightsoil is similarly fermented. At Dengfeng, it was reported that nightsoil is fermented for a period of 7 days before being applied. At Fenghe, nightsoil collected from the brigade's domestic houses, is fermented in open sumps on the farm, together with liquid animal manure, for a period of 3-10 days, depending on the season, only 3 days being required in the hot summer season. However, at Siugong, it was reported that city nightsoil is anaerobically fermented, in closed tanks in the city, for a period of 3-7 days, before being distributed to production brigade farms. It was thought that pathogens, dangerous to human health, were destroyed by the natural heating which occurs during the fermentation process. Similar information was obtained by McCalla and Plucknett (1981: 23-24), who reported that temperatures of $55\,^{o}$ - $60\,^{o}C$ were reached during the fermentation process in commune pits, such temperatures being sufficient to reduce pathogenic organisms to a safe level.

During the writer's visit, it was noticeable that no unpleasant smell emanated from vegetable field sumps containing nightsoil, which would suggest that the nightsoil had been fermented to some considerable extent. When asked about the potential health hazards of using nightsoil as a fertilizer, production brigade leaders replied that local people do not experience any ill health as a result of eating vegetables fertilized with fermented nightsoil. It can be conjectured that local people might have built up a natural resistance to any pathogenic micro-organisms that survive the fermentation process. On the other hand, vegetables exported from Canton to Hong Kong do not cause any health problems in Hong Kong. It is noted though, that the Cantonese always cook their vegetables, albeit only for a few minutes, before eating them.

Domestic rubbish from the city is composted in heaps on the brigade farms for periods of 1 week at Dengfeng, 1 week to 1 month at Fenghe and 1 to 3 months at Siugong. The composted rubbish is cleaned to some extent before it is applied to the vegetable beds, e.g., plastic bags, tin cans and glass bottles are removed. Other dry organic fertilizer materials are also composted on the farms, including some animal manure as well as weeds, poultry feathers and ashes, the latter being obtained from the burning of weeds and shrub branches.

Although it has often been reported that mud from canals and ponds is also used as an organic fertilizer, e.g., by King (1911: 74-75) and McCalla and Plucknett (1981: 33), this traditional practice was not actually seen being used during the writer's visit. Neither was the traditional practice of green manuring seen on the vegetable farms visited.

Organic fertilizers: application rates

Any really meaningful estimation of organic fertilizer application rates is extremely difficult to prepare, because no information is available concerning the exact water content of the different organic fertilizers used. Often animal manure, e.g., pig manure, is diluted with water, when the livestock buildings are washed down. Nightsoil consists very largely of water when it is distributed to the farms and it is often further diluted, by a factor of 4 times, before it is applied to the vegetable beds. Drier composted materials, e.g., composted city rubbish, obviously have a much lower water content.

However, some information on application rates of different organic fertilizers was provided by the brigade leaders, and this information, expressed in metric units, is as follows:

(a) Dengfeng: for flowering white cabbage, liquid pig manure, together with a little nightsoil, cattle manure and rubbish, is applied at a rate of 22.5 t/ha/crop. Assuming an average cropping intensity of 10 crops per year, then the average annual application rate amounts to 225 t/ha/year. This annual rate, though, also assumes that all the crops, whether grown as intercrops or alone, receive the same amount of fertilizer, which is in fact a very crude assumption.

(b) Fenghe: composted rubbish is applied at a rate of 225 t/ha/year, together with a variable amount of nightsoil and liquid manure. Plucknett, Chandler and McCalla (1981: 42) reported figures of 175 t/ha/year of compost and a similar amount of nightsoil for Hsinchiao (Xinjiao) Commune, of which Fenghe is a part.

(c) Siugong: for leafy vegetables, composted animal manure and rubbish is applied at a rate of 15 t/ha/crop and diluted nightsoil at a rate of 30 t/ha/crop, giving a total of 45 t/ha/crop; for bean and gourds, i.e., fruit vegetables, the same organic fertilizers are applied at rates of 22.5 t/ha/crop, respectively, also giving a total of 45 t/ha/crop. Assuming, an average cropping intensity of 6.5 crops per year, then the average annual application rate amounts to 293 t/ha/year. However, this annual rate also assumes that crops grown as intercrops or grown alone receive the same amounts of fertilizer.

In contrast to these application rates, Harwood and Plucknett (1981: 47-50) reported substantially higher application rates, for 7 different vegetable crops grown in Canton, of from 37.5-75 t/ha/crop of compost and 30-75 t/ha/crop of nightsoil, these being applied in varying combinations for the different crops grown.

Organic fertilizers: application timing and placement

Information on the application timing and placement of organic fertilizers was provided by production brigade leaders, as follows:

(a) Dengfeng: liquid pig manure is applied 5 times per crop, at a frequency of once every 3-4 days, as a top dressing during the latter half of the crop growing period. It is also applied to seed beds.

(b) Fenghe: composted rubbish is applied 4 times per year, whereas nightsoil and liquid manure is applied once every 7-8 days, as a top dressing.

(c) Siugong: composted animal manure and rubbish is applied once per crop to leafy and fruit vegetables, as a basal dressing. It is placed in shallow trenches, 0.1 m deep and 0.15 m wide, dug along the centres of the beds. The trenches are backfilled to cover the compost with soil. Composted rubbish is sometimes also applied as a mulch. Diluted nightsoil is applied 5-6 times per crop for leafy vegetables and 8-10 times per crop for fruit vegetables as a top dressing. Fruit vegetables, having longer durations than leafy vegetables, receive a greater number of applications per crop, but each application is smaller in quantity. Nightsoil is applied to the crop beds with scoops filled from buckets.

From this information it can be concluded that liquid organic fertilizers, viz., liquid animal manure and nightsoil, are applied as liquid top dressings, i.e., splashed over the growing crops, every few days. Dry organic fertilizers, viz., composted animal manure and rubbish, are usually applied as basal dressings, being dug into the field beds before the crops are planted. However, composted rubbish is sometimes applied in the form of a mulch.

Chemical fertilizers

The nitrogen fertilizers ammonium sulphate and urea are the only types of chemical fertilizer applied on the brigade farms according to production brigade leaders. No phosphate nor potassium fertilizers are applied.

Production brigade leaders reported that the total application rates of these chemical fertilizers, expressed in metric units, range from 0.11-0.17 t/ha/crop, with an average 0.14 t/ha/crop. Average annual application rates range from 0.8-1.1 t/ha/year, with an average of 1.0 t/ha/year. Plucknett, Chandler and McCalla (1981: 42) reported a figure of 1.125 t/ha/year of chemical fertilizer, with an average nitrogen content of 20 per cent, for Hsin-chiao (Xinjiao) Commune, of which Fenghe is a part. It is noted that all these rates were provided for vegetable crops in general. However, one production brigade leader, viz., Siugong, did report that leafy vegetables and gourds received more nitrogen fertilizers than beans, which is only to be expected as beans are leguminous, nitrogen fixing, plants.

Information on the timing of application was obtained only at Dengfeng, where chemical fertilizer is applied 2 times per crop. Methods of fertilizer placement vary on the different farms. Chemical fertilizer, which is applied as a top dressing and not as a basal dressing, may be mixed with liquid organic fertilizer, the two being applied together, or it may be applied directly to the crop beds in dry form.

Lime is also applied to vegetable crop beds, in order to reduce soil acidity, either just occasionally as required, or, more regularly, between 2 and 4 times per year, at a typical application rate of about 0.3 t/ha/application. One brigade leader, viz., Fenghe, also reported that lime was added to city rubbish in order to hasten the composting process.

An attempt to estimate the total amount of crop nutrients applied in both organic and chemical fertilizers is made in Table 1.4. This table is based on information about fertilizer application rates provided by production brigade leaders and on approximate fertilizer nutrient contents given by Plucknett, Chandler and McCalla (1981: 42-44). The figures for total nutrients applied in Table 1.4, which are probably underestimates, compare reasonably closely with figures calculated by the above writers for Hsinchiao (Xinjiao) Commune, Canton, of 750 kg/ha/year of N, 437 kg/ha/year of P_2O_5 and 585 kg/ha/year of K_2O.

Irrigation

A variety of water sources supplies water for irrigation on the brigade farms, including rivers, underground water and also, at Lianxing, domestic waste water. Both gravity flow of river water and electrically-powered pumps are used to distribute irrigation water, through canals and pipelines, to the vegetable fields. No traditional water lifting devices, such as dragon bone pumps (wooden foot-powered pumps) or swing buckets, were seen in use during the writer's visit.

Table 1.4 Fertilizer nutrients applied to vegetable crops, Canton.

Fertilizer	Nutrient content, % (a)	Dengfeng amount, t/ha/yr	Dengfeng nutrient, kg/ha/yr	Fenghe amount, t/ha/yr	Fenghe nutrient, kg/ha/yr	Siugong amount, t/ha/yr	Siugong nutrient, kg/ha/yr
Composted rubbish		(b) 0		225		(c) 116	
N	0.2		0		450		232
P_2O_5	0.2		0		450		232
K_2O	0.3		0		675		348
Nightsoil		(b) 225		?		(c) 177	
N	0.1		225		?		177
P_2O_5	0.05		113		?		89
K_2O	0.035		79		?		62
Chemical fertilizer		1.1		0.8		0.9	
N	20.0		220		160		180
Total Nutrients							
N			445		610+		589
P_2O_5			113		450+		321
K_2O			79		675+		410

Notes: (a) Nutrient contents of the different fertilizers are taken as being the same as those assumed by Plucknett, Chandler and McCalla (1981: 42-44). The nitrogen content of chemical fertilizer, a mixture of ammonium sulphate and urea (mainly ammonium sulphate), is low at 20%.

(b) Organic fertilizers at Dengfeng consist mainly of pig manure with some nightsoil, cattle manure and rubbish. However, the nutrient content has been assumed to be the same as nightsoil. Although this is a very crude assumption, it does serve to give some indication of the nutrients applied, albeit very approximate. It probably represents an underestimate.

(c) These amounts assume that of the average 6.5 crops grown per year, 4 are leaf vegetables and 2.5 fruit vegetables, as shown in Figure 1.2. The total amount of composted rubbish and nightsoil applied of 293 t/ha/year has been proportioned accordingly. Also in this case composted manure has been assumed to have the same nutrient content as composted rubbish. This also probably represents an underestimate.

On gently sloping land, water was traditionally applied by buckets, which were carried in pairs by farmers, with the aid of a pole across the shoulders. The buckets were fitted with spouts and used as watering cans, being refilled in sumps located near the vegetable beds. Currently though, at Dengfeng, which is located on this kind of land, a sprinkler irrigation system is used. This is a "solid-set" system, i.e., a non-portable system, and it is fitted with rotary head sprinklers. However, bucket watering is still used on the seed beds at Dengfeng.

In low-lying poorly drained areas, e.g., Fenghe and Siugong, the deep furrows or ditches between the high raised beds are used for supplying irrigation water to crops when this is required. Water levels in the ditches are kept sufficiently high to ensure that crop roots receive adequate moisture. In dry weather, water in the ditches is splashed up over the beds with long-handled scoops. To supplement this traditional practice at Fenghe, a solid-set sprinkler irrigation system has recently been installed on a part of the vegetable crop area.

In some low-lying areas, e.g., in a part of Sanyuanli and also at Lianxing, water and in the latter case waste water, is impounded in the levelled, bunded fields, but crop beds are not raised up. In the flooded basins so formed, aquatic crops, such as water spinach, watercress and wild rice, are grown.

Information on the scheduling or frequency of water application was only obtained for Dengfeng. When buckets were used for field bed irrigation, water was applied 3 times per day on hot summer days with no rain and 2 times per day on cool dry winter days.

Field drainage

In the gently sloping areas, with low raised beds separated by footpaths, viz., Dengfeng, and a small part of Sanyuanli, excess rainwater runs off along the footpaths between the beds and into open drains running along the edges of the fields. These drains are usually masonry lined in order to prevent collapse and blockage due to erosion and weed growth.

In the low-lying areas, with bunded fields, high raised beds and deep furrows or ditches, viz., Fenghe and Siugong, excess water drains off along the ditches. Even when the land floods during or just after heavy rain, the top surfaces of the beds stay above the water level, except in very occasional cases of severe flooding. This field, bed and ditch layout makes it possible to grow vegetable crops successfully in low-lying areas during the wet season. In the lowest lying vegetable fields, e.g., at Fenghe, the removal of flood water is assisted by pumping water from the field ditches into canals leading to the river. Traditionally, the pumps were of the wooden foot-power (dragon bone) type, as described by King (1911: 78-79), but these have been replaced in recent years by electrically-powered pumps.

Weeds and weed control

Serious weed infestations in growing crops were not seen on any of the vegetable farms visited around Canton. It is very apparent that the high intensity of cropping greatly reduces weed growth. Animal ploughing and hoe cultivation before planting also reduces weed growth. The few weeds that do grow on vegetable beds are hoed or pulled up by hand.

Herbicides are rarely used, except at Dengfeng where they are used before cultivation prior to planting. Herbicides are also occasionally used to kill weeds that grow on the sides of high raised beds and ditches at Siugong. However, at Fenghe, aquatic weeds that grow in the ditches are harvested and fed to pigs. In other areas weeds removed from the crop beds are added to compost heaps.

Pests and pest control

A list of the pests of vegetable crops and the insecticides currently used in their control, for the Canton area, is given in Table 1.5. Insecticides are sprayed on to the crops with simple hand-operated portable sprayers. Typical spraying frequencies mentioned by production brigade leaders were 2-3 times per crop for leafy vegetables and 6-7 times per crop for beans and gourds, viz., fruit vegetables. Brigade leaders also reported that traditionally, up to about 1960, nicotine and derris were applied as insecticides. Nicotine was extracted from the leaves of tobacco plants and derris was extracted from the roots of **Derris elliptica**.

No mention was made of nematodes being a problem, and as reported by Williams (1981: 161) nematode problems are rare on vegetables in China generally, possibly because, as with soil-borne insects and pathogens, crop rotations, flooding, and heavy application of organic fertilizers may suppress nematode build-up.

As Williams (1981: 134-136) pointed out a wide range of preventive measures and cultivation practices, apart from chemicals, are used to control insect pests. Keeping the crop beds clean, by removing weeds and crop residues after harvest, reduces the chances of survival and carry-over into the next crop of a number of pests and diseases.

Table 1.5 Main insect pests of vegetable crops and insecticides used in their control, Canton.

Main insect pest: Latin Name	Main insect pest: English Name	Insecticides used (or recommended)[c]
Pieris rapae	Common cabbage worm[a]	Dipterex, DDVP
Plutella xylostella	Diamond back moth[b]	Dipterex, DDVP
Prodenia litura	Tobacco cutworm[a]	Dipterex, Orthene
Leucinodes orhonalis		DDVP
Polyphagotarsonemus latus		TDN, Kelthane
Maruca testulalis	Bean pod borer[b]	DDVP, Sumithion, malathion
Phytomyza atricornis	Leaf miner[a]	DDVP
Aphis gossypii	Cotton aphid[a]	Orthene, dimethoate, derris
Rhopalosiphum pseudobrassicae	Turnip aphid[a]	Orthene, dimethoate, derris
Myzus persicae	Peach-potato aphid[b]	Orthene, dimethoate, derris
Thrips flavus	Thrips[b]	dimethoate + Imidan, Orthene, NRDC 143, malathion

Source: Personal communication from Professor Lin King-hsun, South China Agricultural College, 1981.

Notes: (a) English names from Williams (1981: 373-374).

(b) English names from various other sources.

(c) Common chemical names of proprietory products are:

Dipterex	=	trichlorfon
DDVP	=	dichlorvos
Orthene	=	acephate
Kelthane	=	dicofol
Sumithion	=	fenitrothion

Common chemical names of TDN, Imidan and NRDC 143 are not known to the writer. The names malathion and dimethoate are common chemical names.

Rotation of crops prevents the build-up of soil-borne pests and diseases, especially as many different types of vegetables are grown that are not susceptible to the same pests and diseases. Breaking down the crop beds, flooding the soil and growing a rice crop once every few years enhances the effect of rotation on soil-borne pests and diseases. Interplanting may sometimes help to reduce the local development and spread of insect pests and diseases, provided that the interplanted crops are not susceptible to the same pests and diseases. High soil fertility, traditionally built-up by using organic fertilizer, increases the vigour of crop plants, which helps to minimize the effects of pests and diseases on them.

Diseases and disease control

Fungal diseases, mainly downy mildew and powdery mildew, were reported to be problems and are controlled by the spraying of fungicides, e.g., Daconil (chlorothalonil) and carbendazim. Fungicide spraying frequencies, reported at Siugong, were as follows: beans and gourds, viz., fruit vegetables, are sprayed 3-5 times per crop, but leafy vegetables are seldom sprayed.

Virus disease was reported to be a minor problem affecting flowering white cabbage and Chinese white cabbage, if these crops are transplanted; but if they are directly sown the disease can be prevented. It is possible, although not certain, that the virus disease is the same as the turnip mosaic virus reported to infect Chinese white cabbage in Canton by Williams (1981: 155).

Williams (1981: 157) also reported that clubroot, **Plasmodiophora brassicae** is very rarely if ever a problem of crucifers (cabbages and and mustards) which is surprising considering the dominant position of crucifers in Chinese vegetable cropping. He suggests the abscence of this, and certain other soil-borne diseases, is probably due to the crop rotations and other cultural, i.e., non-chemical, methods used.

Harvesting and packing

When ready for harvest, some leafy vegetables are cut, e.g., flowering white cabbage, water spinach and Chinese chives, while others are pulled up with their roots on, e.g., leaf mustard, celery, Chinese spinach, spinach, garland chrysanthemum and shallots. Fruit vegetables are picked as the individual fruits ripen. Harvesting of vegetables may be completed in one day or it may extend over a long time period, as shown in Table 1.3, ranging for example, from 10 days for flowering white cabbage, to 30 days for wax gourd, to 120 days for water spinach grown under flooded field conditions.

The harvested vegetables are not usually washed before packing, unless they are harvested with roots on or are harvested in wet weather and are dirty.

Bamboo baskets were not seen in use on any of the farms visited, nor were any other packing materials seen. It was apparent that vegetables are transported to the city in bulk, in small tractor-drawn trailers, or sometimes in trucks. However, one brigade leader, viz., Dengfeng, reported that bamboo baskets were used for packing vegetables exported to Hong Kong.

CROP YIELDS

Yield per crop

Yield data, provided by production brigade leaders, for the different vegetable crops grown are set out in Table 1.6. Comparable yield data

Table 1.6 Vegetable crop yields, Canton.

Crop	Number of samples	Range of yields, t/ha/crop	Yield or average yield, t/ha/crop
Flowering white cabbage	3	6.0-15.0	10.4
Chinese white cabbage	1		7.5
Celery cabbage	1		22.5
Chinese kale	1		18.8
Leaf mustard	1		22.5
Chinese spinach	1		15.0
Lettuce	1		18.8
Celery	1		45.0
Water spinach (dry bed)	2	15.0-22.5	18.8
Spinach	1		30.0
Garland chrysanthemum	1		18.8
Chives	1	15.0-22.5	18.8
Chinese chives [(a)]	1		5.6
Yard-long beans	3	7.5-11.3	9.3
Cucumber	1		15.0
Oriental pickling melon	1		15.0
Wax gourd	2	17.3-22.5	19.9
Angled loofah	2	None	18.8
Bitter cucumber	1		18.8
Shallots	1		18.8
Ginger	1		11.3
Yam bean	1		3.8
Greater yam	1		18.8
Taro	1	18.8-30.0	24.4

Source: Discussion with production brigade leaders (Dengfeng, Fenghe and Siugong), 1981.

Note: (a) Yield per harvest or cut, based on an annual yield of 45.0 t/ha/year divided by 8 harvests per year, as shown in figure 1.2.

for Canton, reported by Harwood and Plucknett (1981: 48-50), are as follows: angled loofah, 18.75-30.0 t/ha/crop; ginger, 11.25 t/ha/crop; yam bean, 45-75 t/ha/crop; and taro, 18.7-33.75 t/ha/crop.

Interplanting is likely to have some effect on crop yields, but information on the size of this effect was not obtained, apart from three instances reported at Siugong. These were as follows: flowering white cabbage grown as a single crop yields from 10.5-11.3 t/ha/crop, but when grown as an intercrop with trellised root or fruit vegetables yields 6.0 t/ha/crop; chives grown as a single crop yields 22.5 t/ha/crop, but when grown as an intercrop with trellised root vegetables yields 15.0 t/ha/crop; taro grown as a single crop yields 30.0 t/ha/crop, but when grown as an intercrop with ginger and trellised root crops yields 18.8 t/ha/crop.

Although the extent to which interplanting depresses the yields of individual crops grown together on the same bed was not fully determined during discussions with production brigade leaders, it was noted that the practice of interplanting, which requires a great deal of labour, is very widespread. Hence, it seems reasonable to conjecture that the aggregate yield of two interplanted crops is probably greater than the yield of either of the crops if they were grown alone on the same bed during the same time period. If that were not so, then there would be no point in using a lot of labour in interplanting.

Annual yield

General estimates of the annual yield of all vegetables grown, taken together, on a per hectare basis, were provided at Fenghe and Lianxing. At Fenghe, the Chinese chives based cropping pattern was reported to give an annual yield of 75 t/ha/year. However, it seems to the writer that this estimate may well be too low, bearing in mind the number of interplanted leafy and fruit vegetable crops grown in this pattern, as shown in Figure 1.2. At Lianxing, the water spinach and watercress cropping pattern was reported to give an annual yield of 135 t/ha/year.

More detailed information on annual yields was obtained at Siugong. Here crop yields were obtained for each of the crops grown in the 3 cropping patterns shown in Figure 1.2. These crop yields are set out and summed, for the respective cropping patterns, in Table 1.7. Excluding the private plot pattern, which is not typical of field cropping patterns, the annual yields at Siugong range from, approximately, 70-85 t/ha/year.

Plucknett and Beemer (1981: 5), in introducing their book, state that the government goal for vegetable yields in China generally is 75 t/ha/year. Farmers in Canton certainly appear to be meeting and exceeding this goal.

There is some evidence that vegetable crop yields have been increasing in recent years, but the extent to which these increases can be attributed to the use of modern Western practices is hard to determine. The leaders of Fenghe Production Brigade in Xinjiao Commune reported to the writer that vegetable crop yields were now (1981) 30% higher than before 1949. The reasons underlying the increases were said to be more intensive cropping, with more interplanting, more rotation, and greater use of fertilizer, especially chemical fertilizers. However, it was also said that farmers apparently try to use minimal amounts of chemical fertilizers, as these are thought to affect the taste of the vegetables.

Table 1.7 Annual crop yields, Siugong Production Brigade, Canton.

Cropping pattern, 6 crops per year	yield, t/ha	Cropping pattern, 7 crops per year	yield, t/ha	Cropping pattern, 8 crops per year	yield, t/ha
FWC	6.0	Chives	15.0	FWC	11.3
Wax gourd	17.3	Angled loofah	18.8	Taro	18.8
FWC	6.0	FWC	6.0	Ginger	11.3
Yard-long bean	7.5	Yard-long bean	7.5	Greater yam	18.8
FWC	10.5	Cucumber	15.0	Yam bean	3.8
Celery cabbage	22.5	FWC	11.3	Water spinach	15.0
		FWC	11.3	Chives	22.5
				FWC	6.0
Total annual yield, t/ha/year	69.8		84.9		107.5

Source: Discussion with production brigade leader, 1981.

Notes: (a) Cropping patterns as illustrated in Figure 1.2, with crops listed in this table in calendar order starting from January.

(b) FWC = Flowering white cabbage.

Leaders of Hsinchiao (Xinjiao) Commune reported to Chandler (1981: 18) that recent extensive drainage and irrigation improvements in the commune had made it possible to double crop yields since 1958. These improvements consisted of the construction of ditches and dykes and also the installation of 78 pumping stations.

LABOUR USE

Labour use per hectare

Estimates of the numbers of vegetable farm workers, per hectare of vegetable crop land, for 3 of the production brigades visited, were made earlier in this chapter, in the "Farm labour supply" section. The numbers of workers, or persons, per hectare were estimated as 27.8 at Dengfeng, 19.4 at Fenghe and 16.5 at Siugong, with an average of 21.2 for the 3 farms.

Labour use per hectare per crop

Taking the cropping intensities, or number of crops grown per bed per year, for the 3 brigade farms, from Figure 1.2, as 10, 12.5 and 6.5 respectively, then the numbers of persons, or labour use, per hectare per crop are 2.8, 1.6 and 2.5 for Dengfeng, Fenghe and Siugong, respectively, with an average of 2.3 for the 3 farms. It is noted that the cropping intensities taken from Figure 1.2 are averages in the cases of Fenghe and Siugong, and in the latter case the private plot is excluded.

Field layouts and high raised beds in low-lying, wet land. Land preparation with hoe

Field layouts and low raised beds on gently sloping land. Rice straw mulch

Overhead protection of seed beds

Vegetable farming in Canton

Plate 1.1

Trellising over ditches (wax gourd)

Tying crop to trellis (cucumber)

Clay pots for blanching Chinese chives

Vegetable farming in Canton

Plate 1.2

Interplanting (Chinese chives with flowering white cabbage)

Nightsoil and animal manure stored in field sump prior to application

Applying composted rubbish

Vegetable farming in Canton

Plate 1.3

Hand watering with long-handled scoop

Sprinkler irrigation system

Weeding and bed preparation with hoes prior to interplanting

Vegetable farming in Canton

Plate 1.4

TRADITIONAL PRACTICES

Identification

The traditional vegetable farming practices used in Canton have been described along with introduced modern Western farming practices, in the preceding "Current practices" sections of this chapter. In order to identify clearly which of the current practices are traditional, the modern Western practices must first be "filtered out". As a means of doing this, the modern Western practices may be considered to be as follows:

(a) the use of chemical fertilizers, viz., ammonium sulphate and urea, and the use of chemical pesticides (biocides), viz., herbicides, insecticides and fungicides; and

(b) the use of fossil fuel powered agricultural machines, viz., irrigation pumps and sprinkler systems, drainage pumps, and tractors and trailers for transportation.

After filtering out these modern Western practices, a list of traditional Chinese practices can be drawn up. In Table 1.8, the column headed, traditional practice, represents an attempt to do this.

Main characteristics

The use of traditional practices can be thought of as having effects, that is beneficial effects, on the productivity of land, through raising either crop yield, i.e., yield per crop, or cropping intensity, i.e., the number of crops grown per year, or both.

The effects of using individual traditional practices are listed in Table 1.8. These effects may be grouped together into 4 separate groups, viz., multiple cropping, control and efficient use of water, build-up of soil fertility, and control of weeds, pests and diseases. An attempt to show the way in which these 4 groups interact to result in high crop yields, high intensity of cropping, and consequent high annual crop production, is made in Figure 1.3.

It can be seen in Figure 1.3 that high crop yields result from the control and efficient use of water, the build-up of soil fertility and the control of weeds, pests and diseases. Similarly, it can be seen that high cropping intensity results from multiple cropping, and also from the control and efficient use of water and the build-up of soil fertility, without which successful multiple cropping would not be sustainable.

The use of traditional practices can also be thought of in the context of a vegetable farming system, in which there is interaction between vegetable fields, livestock units and the urban population. The basic elements of the traditional vegetable farming system of Canton are shown in Figure 1.4

Table 1.8 Traditional vegetable farming practices and the effects of using them, Canton.

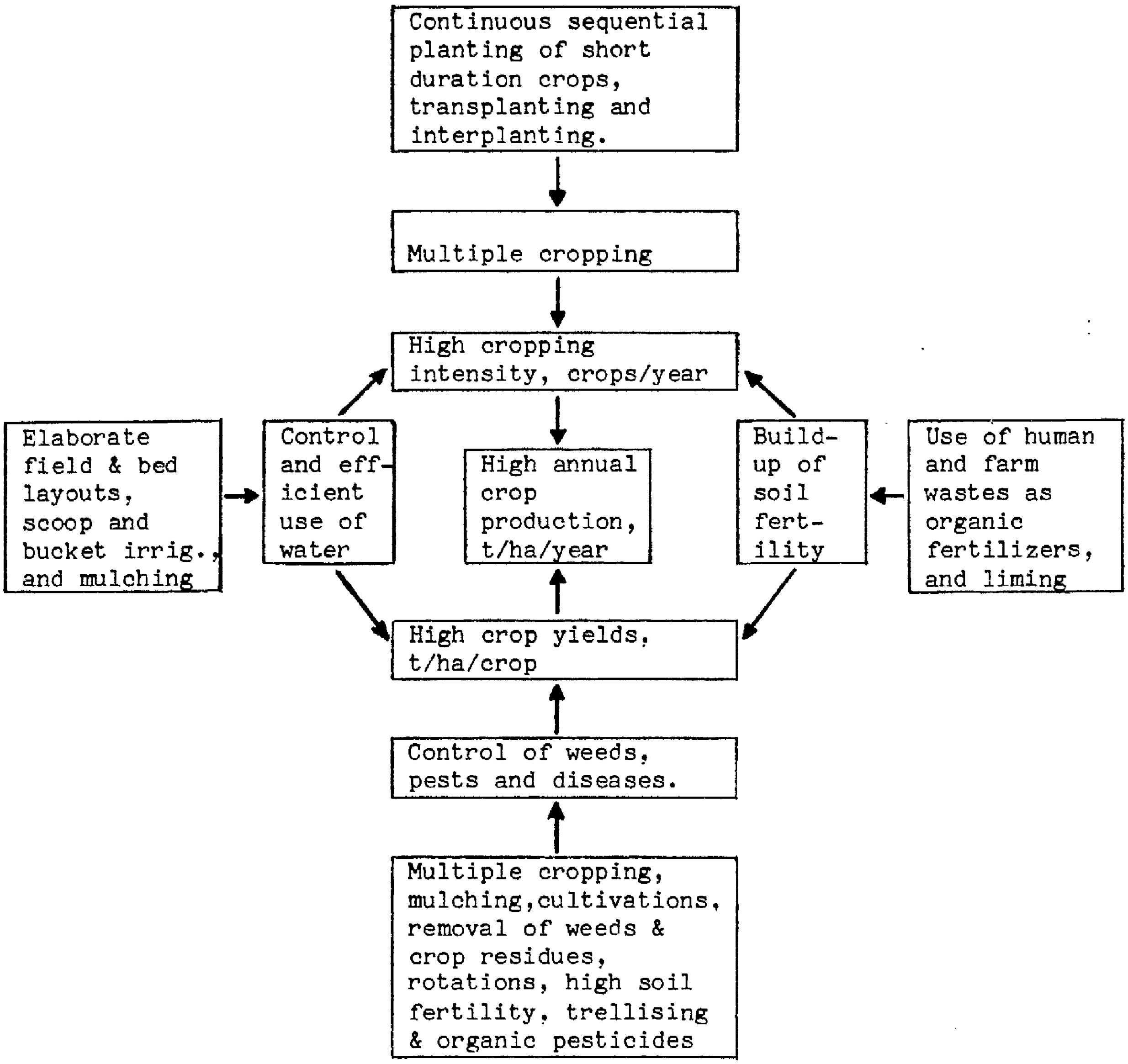
Traditional practice	Effect of using traditional practice	
Continuous sequential growing of short duration crops	Enables many crops to be grown in one year	Multiple cropping
Transplanting	Reduces length of time that crops require in field beds, so enabling more crops to be grown in one year	Multiple cropping
Interplanting	Makes efficient use of all available space in field beds, so enabling more crops to be grown in one year	Multiple cropping
Levelling and bunding of fields	Facilitates water control in low-lying poorly drained areas	Control and efficient use of water
Raised beds with footpath or ditches between	Facilitates good drainage and soil aeration, provides easy access to crop plants and, in the case of ditches, supplies water for irrigation	Control and efficient use of water
Mulching and overhead protection of seed beds	Protects seedlings from damage by heavy rainfall and reduces water losses from crop beds in dry weather	Control and efficient use of water
Trellising	Enables space between raised beds to be covered by a maximum crop leaf area, and not wasted	Control and efficient use of water
Bucket and scoop methods of irrigation	Promotes careful watering and efficient water use	Control and efficient use of water
Use of animal and human wastes and crop residues and weeds as organic fertilizers, after due preparation	Replaces plant nutrients removed from soil when crops harvested. Improves soil structure, e.g., improves soil aeration in heavy soils and water holding capacity in light soils. Stimulates soil microbial activity which increases nutrient availability	Build-up of soil fertility
Liming	Reduces high soil acidity, associated with leaching under heavy rainfall conditions.	Build-up of soil fertility

Table 1.8 (continued) Traditional vegetable farming practices and the effects of using them, Canton.

Traditional practice	Effect of using traditional practice	
Multiple cropping and mulching of seed and field beds	Reduces weed growth	Control of weeds, pests and diseases
Animal ploughing and hoe cultivation	Destroys weeds before crops planted.	
Hoeing and hand pulling of weeds	Removes growing weeds	
Rotation of crops, including flooding during break crop of rice	Reduces survival of soil-borne pests and disease organisms	
Interplanting	Reduces spread of some pests and disease organisms	
Removal of weeds, and crop residues after harvest	Removes pest and disease reservoirs, so preventing pest and disease build-up	
Build-up of high soil fertility with organic fertilizers	Increases vigour of crop plants minimizing effects of pests and diseases	
Trellising	Overcomes problem of fruit vegetables rotting on the ground, and also protects vegetables from excess direct sunlight	
Use of organic pesticides	Reduces crop pest infestations	

Note: Additional practices not listed in this table but used traditionally in Canton are: staggering of planting dates, diversified cropping, use of clay pots for blanching Chinese chives, water lifting by dragon bone pumps and the use of bamboo baskets for transporting harvested produce. These practices are not listed in the table as they do not have a direct effect on the productivity of land.

Figure 1.3 The achievement of high annual crop production in vegetable farming, through the use of traditional practices, Canton.



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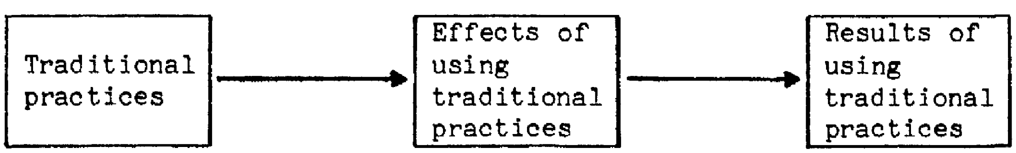
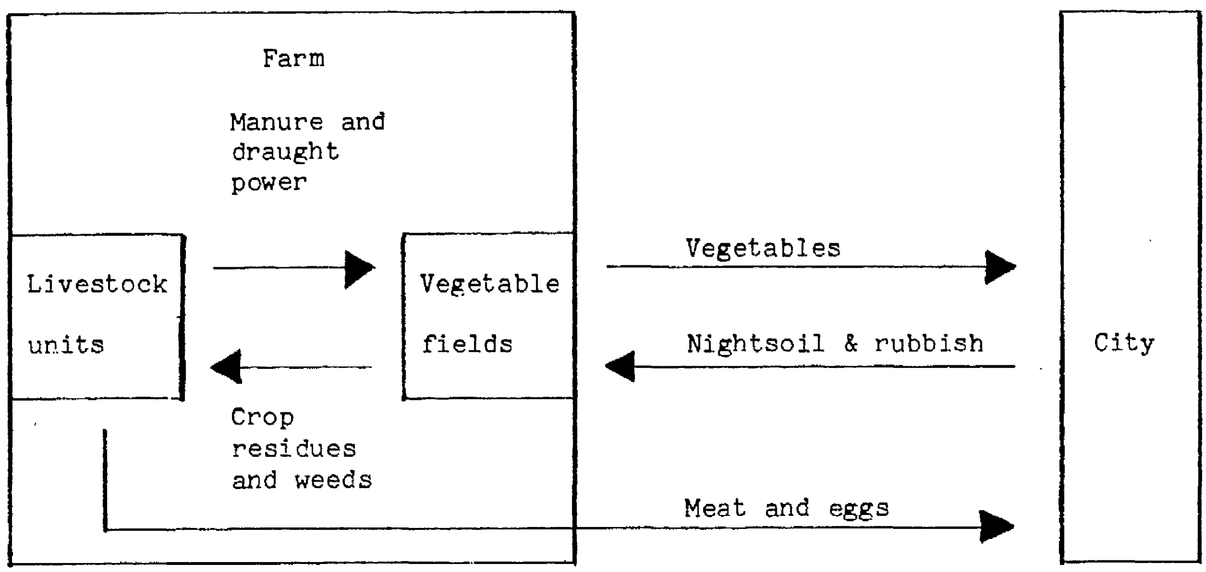


Relationships between practices and results of using them.

Figure 1.4 Traditional vegetable farming system, Canton.



Notes: (a) Livestock units consist of pigs, cattle, water buffalo and poultry.

(b) Crop residues and weeds provide only part of the livestock feed requirements; grain, fodder crops or food processing wastes may also be used to meet feed requirements.

In terms of the main characteristics of traditional Chinese vegetable farming practices, Figure 1.3 only shows how the use of traditional practices results in high annual crop production. Before it can be accepted though that the use of traditional practices results in crop production levels which are high on any kind of international scale, some comparison must be made between crop production levels in Canton and those in other countries. Such a comparison should ideally cover a wide spectrum of countries, including both developed countries, where high levels of modern Western practices are used, and developing countries, where much lower levels of modern Western practices are used. For the purpose of making such a comparison five countries have been selected. These are the USA and Japan, to represent developed countries, and the Philippines, Indonesia and Fiji, to represent developing countries. The reason for selecting these particular countries for comparison is that some comparable vegetable crop yield data for them have been found, in a general situation in which very few comparable data are available at all. Table 1.9 is a comparison of vegetable crop yield data for these countries.

Before looking for any significant patterns in Table 1.9, it should be realized that there are some limitations regarding the strict comparability of the data. Firstly, there is no information available concerning any differences in crop variety or in the age or size of crop plants at the time of harvest in the different countries, although basically the crop plants are the same in the different countries and they are harvested at more or less the same growth stage. The data should be considered then as only indicating approximately the differences that exist in crop yield levels. Secondly, the methods of deriving these crop yield data in the different countries vary. In Canton, average yield data, i.e., yields

Table 1.9 Comparison of average vegetable crop yields in Canton and selected countries, in t/ha/crop.

	Canton (1)	USA (2)	Japan (3)	Philippines (4)	Indonesia (5)	Fiji (6)
Chinese white cabbage	8			8		
Celery cabbage	23		40	10	7	3
Leaf mustard	23			8		
Lettuce	19	28	20	8		2
Celery	45	63	46			
Spinach	30	16	15			
Yard-long beans	9			8	2	2
Cucumber	15	12		15		2
Bitter cucumber	19			12		
Shallots	19				4	
Taro	24		13			

Sources: 1. Fieldwork, 1981.

2. Ware and McCollum (1975: 284.315,329,439).

3. Yamakawa (1979: 27).

4. Rodriguez and Tisbe (1969: 221-222).

5. Harjadi (1979: 76).

6. Chandra (1979: 120).

Notes (a) USA data are national average yield data; based on total production divided by harvested area; original units: cwt/acre.

(b) Japan data are also national average yield data, based on total production divided by planted area.

(c) Philippines data are average values of "expected yields".

(d) Indonesia data are "average yields".

(e) Fiji data are "reliable estimates of yields".

per hectare per crop, were provided by production brigade leaders on the basis of their own experience. In the USA and Japan, the figures available are average yields based on dividing the total national production by the harvested or planted area for the particular crops. These figures approximate to average yields per hectare per crop. In the Philippines, Indonesia and Fiji, the yield data available were expressed as "expected", "average" and "estimated" yields, respectively. These yield data though are yields per hectare per crop..

The general picture that emerges from Table 1.9, then, is as follows. The average vegetable yields in Canton, i.e., yields per hectare per crop, when several different crops are considered together, are more or less similar to those in the developed countries of the USA and Japan. However, the average vegetable yields in Canton are generally higher than those in the developing countries of the Philippines, Indonesia and Fiji. Hence, average vegetable yields in Canton may reasonably be considered to be high on an international scale.

Unfortunately, no comparable data on the average number of vegetable crops grown per year have been found. However, by any standard, the figure of around 10 vegetable crops grown per year in Canton is extremely high. It is quite probably much higher than comparable figures in either the USA or Japan, where cold winter temperatures greatly reduce the prospects for multiple cropping under open field conditions, as opposed to under heated glasshouse conditions. Hence, as both crop yields, i.e., yield per crop, and intensity of cropping, i.e., the number of crops grown per year, are high in Canton, it is maintained that crop production levels in vegetable farming in Canton are indeed high. Such a view is supported by Plucknett and Beemer (1981: 5) who observed that vegetable yields are very high in most producing areas of China generally.

It is apparent though that, at present, modern Western vegetable farming practices have been introduced only to a very limited extent in Canton and most of the current practices are traditional. There is no mechanized land preparation and fertilizers are still mainly organic, although there has been some introduction of mechanized water pumps and chemical biocides. It is quite possible, therefore, to say with some confidence, that crop production levels were probably not much lower, if indeed at all, in the recent past before modern Western practices were introduced. Hence, it can be said that it is the use of traditional practices in vegetable farming in Canton which results in high crop production levels. Therefore, it is maintained that **the use of traditional Chinese vegetable farming practices in South China is characterized by high productivity of land.**

Since traditional Chinese vegetable farming practices do not involve the use of any motor-powered agricultural machines or any synthetic agricultural chemicals, no fossil fuel energy is required for the manufacture or application of such inputs. It could be argued though that small quantities of fossil fuel are required for the manufacture of traditional metal hand tools and ploughshares. However, the amounts of fossil fuel so consumed are extremely low in comparison with the amounts used in the manufacture of agricultural machines and chemicals. Hence, it is maintained that **the use of traditional Chinese vegetable farming practices is also characterized by negligible use of fossil fuel energy.** Moreover, since traditional Chinese vegetable farming practices do not involve the use of any agricultural chemicals, either fertilizers or biocides, the problem of pollution of the environment with chemicals does not arise. Hence, it is maintained that **the use of traditional Chinese vegetable farming practices is also characterized by negligible pollution of the environment.**

Finally, it is very apparent that, currently, vegetable farming in Canton is extremely labour intensive, with some 20 persons employed per hectare. Plucknett and Beemer (1981: 5) observed that vegetable production in China uses the most intensive farming systems in the country, or for that matter in the world, much of the vegetable cultivation being painstakingly carried out by hand. Hence, it is maintained that the **use of traditional Chinese vegetable farming practices is also characterized by high use of labour.**

CONCLUSION

The use of traditional practices in the intensive vegetable farming system of Canton is characterized by:

(i) high productivity of land,

(ii) negligible use of fossil fuel energy,

(iii) negligible pollution of the environment and

(iv) high use of labour.

Hence, these practices represent potentially suitable alternatives to modern Western practices in vegetable farming in Southeast Asia, in the context of this study, as discussed in the Introduction in the section headed, "Towards an alternative strategy".

Subsequent chapters in the thesis will be concerned with the question of whether or not these traditional Chinese practices could be successfully used in Southeast Asia. However, before focusing on this question, a second baseline case study of vegetable farming in South China, a study of Hong Kong, is included in order to provide supplementary information on the use of the same traditional practices in a very different human environment in South China.

CHAPTER 2

VEGETABLE FARMING IN SOUTH CHINA: A BASELINE CASE STUDY OF HONG KONG

INTRODUCTION

This chapter focuses on the environment and practices of vegetable farming in Hong Kong, in particular in the New Territories, the location of which is shown in Figure 2.1. The aim of the chapter is to provide supplementary data for the baseline study of vegetable farming in Canton. The current vegetable farming practices used in the New Territories consist of traditional Chinese and modern Western practices.

Most of the information on current practices in this chapter was obtained during the writer's fieldwork in the New Territories in July 1981. In the course of this fieldwork 7 farmer interviews were conducted. Where available, comparable and confirmatory information from previous literature is also included in this chapter, in the relevant sections.

PHYSICAL AND HUMAN ENVIRONMENT

However, before describing the current vegetable farming practices, information on the environment of vegetable farming is required and this is set out in Tables 2.1 - 2.3. The vegetable farms visited are located in the Sai Kung, Tuen Mun and Yuen Long Districts of the New Territories, as shown in Figure 2.1.

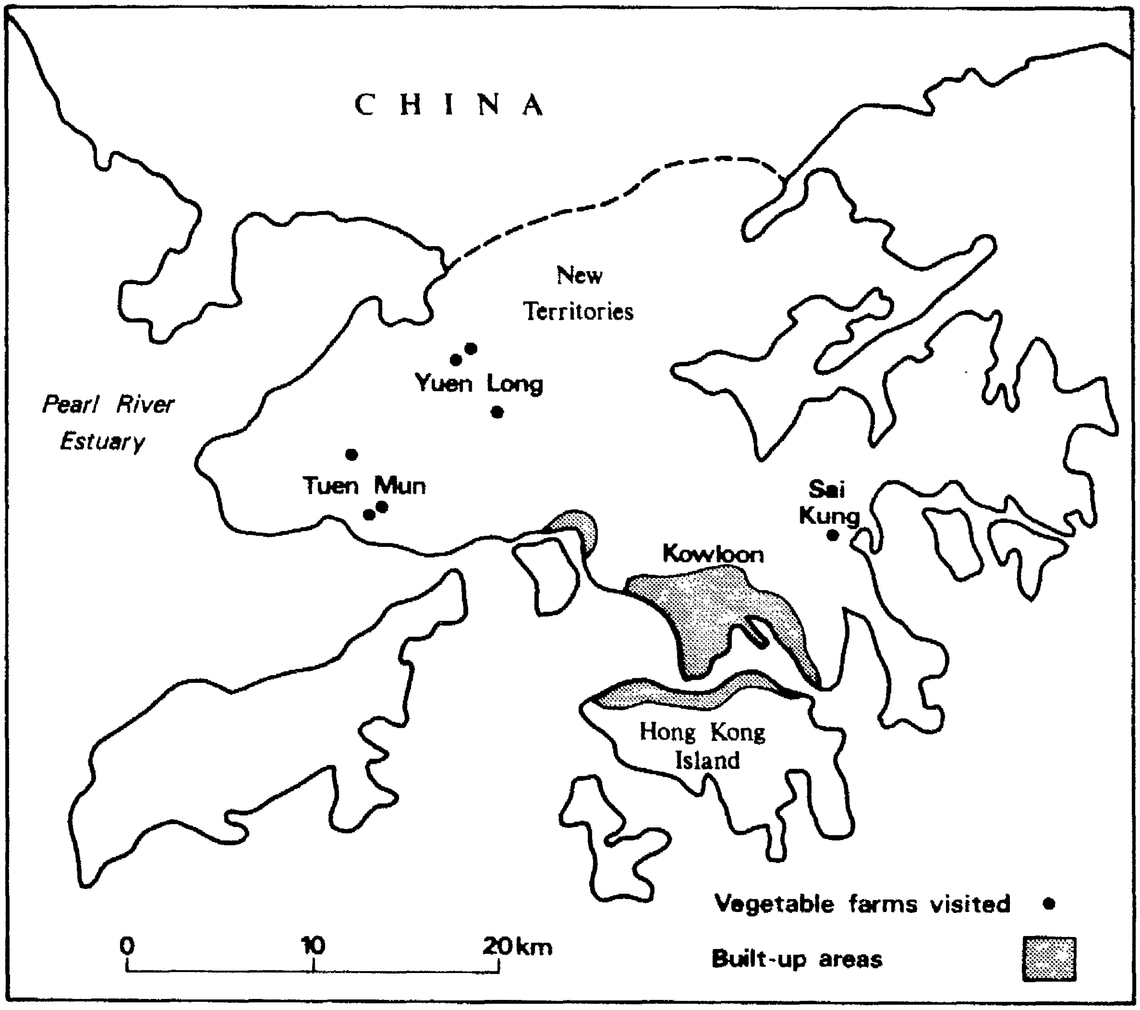


Figure 2.1 Locations of vegetable farms visited in Hong Kong.

Table 2.1 Physical environment, Hong Kong.

Relief	Altitude	Lowland, near sea level to 30m.
	Landform	Plains, valley floors and hillsides.
	Slope	Flat to gently sloping plains and valley floors, to moderately sloping hillsides.
Natural drainage		Variable, poor and good.
Climate	Type	Monsoon (details in Table 2.2)
	Seasonality (simplified)	Cool dry season, warm rainy season
	Typhoons	Some.
Soils	Texture	Variable, coarse sand to sandy clay loam.

Source: Fieldwork, 1981.

Table 2.2 Mean monthly temperature and rainfall, Hong Kong.

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Mean monthly temperature, ^{o}C	15	15	18	21	25	27	28	28	27	25	21	17
Mean monthly rainfall, mm	32	47	72	136	293	401	372	371	279	99	43	25

Source: Hong Kong Government (1977: 270).

Notes:

(a) Average mean monthly temperature is 22 ^{o}C.

(b) Mean monthly temperature range is 13 ^{o}C.

(c) Total annual rainfall is 2,169mm.

(d) Frost is rarely experienced (Wong 1971: 93).

(e) Latitude: 22^{o} N.

(f) Longitude: 114^{o} E.

Table 2.3 Human environment, Hong Kong.

Market	Main market	Hong Kong (entire territory)
	Size of market	5 million people
	Proximity to market	Near, i.e., less than 50 km
	Transportation	Truck
	Marketing channel	Most through government controlled Vegetable Marketing Organization (VMO), some through dealers
Farming structure	Farm size, range, ha	0.2 - 0.7
	Farm size, average, ha	0.4
	Vegetable area " "	0.1-0.7
	Livestock numbers	None on most farms (some pigs and poultry on a few farms)
	Land tenure	Mostly rented, some owned
	Farm access	Road, some by short footpath to road
Farm labour supply	Source of farm labour	Farmer and his family, very little hired labour
	Farmer's family size (ave)	6
	Farmer's experience, average years	26
	Race of farmers	All Chinese
	Dialect group of farmers	Cantonese, Hakka, Teochiu and Kwangsi
Farm input supply	Organic fertilizer, sources	Variable: dealers, cooperatives, nearby farms, own farm.
	Chemicals and machines, sources	Dealers and cooperatives
	Seed, bought or saved	Most saved on farm
	Water, sources	Streams and groundwater.

Source: Fieldwork, 1981.

CURRENT PRACTICES

Vegetable crops grown

The vegetable crops grown on the 7 farms visited in the New Territories are listed in Table 2.4. The crops most commonly grown, i.e., those grown on 3 or more of the farms, are flowering white cabbage, Chinese kale, Chinese spinach, lettuce, spinach and shallots/spring onions.

Wong (1971: 142) reported that there were over sixty kinds of vegetables grown in Hong Kong, some of which were grown in the cool dry season and some in the hot wet (warm rainy) season and some at any time of the year. Of these, the following 15 were grown on a comparatively large scale: flowering white cabbage, Chinese white cabbage, Chinese kale, leaf mustard, Chinese spinach, lettuce, water spinach, watercress, spinach, Chinese chives, yard-long bean, tomato, eggplant, spring onion and Chinese radish.

Intensity of cropping

On the 7 farms visited 4-12 crops per year are grown on the same beds, with an average of 8.2 crops per year. Wong (1971: 154), reporting the results of a 3 year investigation into multiple cropping on 47 fields in 6 different vegetable farming areas, showed that 11% of the fields were planted to 3 crops per year, 38% were planted to 4-6 crops per year and 51% were planted to 7-9 crops per year. Tregear (1958: 38) commented that as many as 8 crops per year were grown on some vegetable farm lands. Ng (1965: 98) reported that in the Tung Chung area of Lantau Island 8 crops per year were grown.

Table 2.4 Vegetable crops grown, sample durations and planting methods, Hong Kong.

Crops grown	Duration, days(1)	Planting method(1)	Duration, days(2)	Planting method(2)
Leafy vegetables				
Flowering white cabbage	20-60	T	20-50	T
" " "	50-80	DS		DS
Chinese white cabbage	35	DS		
Chinese kale	40-90	T		
Leaf mustard				
Chinese spinach	25-60	DS		
Lettuce	20-40	T		T
Water spinach	60	T		
Spinach				DS
Garland chrysanthemum	35	T		
Coriander	45	DS		
Chinese box thorn				
Chinese Chives	8-24 mths	T		
Fruit vegetables				
Yard-long bean				DS
Wax gourd				
Eggplant				T
Root vegetables				
Shallots/spring onions	40-45	T		
Carrots				DS

Sources: 1. Fieldwork, 1981.

2. Wong (1971: 166).

Notes: (a) All time periods given in days, rounded to the nearest 5 days.

(b) DS = Directly sown. T = Transplanted.

(c) Durations relate to time in field beds.

Crop durations

Information on crop durations was obtained from 6 of the farms visited and is given in Table 2.4, together with comparable information from previous literature.

Planting Methods

Most leafy vegetables are sown in nurseries and transplanted as can be seen from Table 2.4. Chinese white cabbage, Chinese spinach and coriander are directly sown though, as occasionally is flowering white cabbage in the warm rainy season. Shallots/spring onions are transplanted.

Interplanting

Vegetable crops are sometimes interplanted by 4 of the 7 farmers visited. Interplanting of long duration crops with short duration crops is occasionally practised, e.g., interplanting Chinese chives with Chinese kale and Chinese box thorn with leaf mustard. Also, relay interplanting of two short duration crops is occasionally practised, e.g., a maturing flowering white cabbage crop may be interplanted with lettuce seedlings, the former giving shade to the latter, or intersown with Chinese spinach, one week before harvest. Wong (1971: 159) reported the same two kinds of interplanting and stated that interplanting was a very common practice.

Staggering of planting dates

Staggering the planting dates of crops is practised by most of the farmers interviewed. On the same farm on the same day, the same crop may be seen at different stages of growth on the different field beds. For example, on one farm visited 6-10 beds of Chinese spinach were sown at 20-30 day intervals about 4-5 times during the warm rainy season. On two other farms, the intervals between separate planting dates of flowering white cabbage varied from 5-7 days. On another farm, the intervals between separate planting dates of flowering white cabbage and also Chinese kale were 14 days. The farmers concerned described staggering of planting dates as a means of spreading labour peaks and saving labour and also obtaining a stable income.

Diversified cropping

A range of different leafy, fruit and root vegetable crops is grown at the same time in different fields of the same farms. Wong (1971: 160) commented that diversified cropping spreads the risk of price fluctuation and crop failures and evens out the distribution of labour over time.

Crop rotations

Crop rotation is practised by all of the farmers, but the crops are not rotated according to any particular order. Seasonality is a major factor affecting the choice of which crops are grown at particular times. Cool season crops, e.g., Chinese kale and spinach, are grown in the cool, dry winter season. Warm season crops, e.g., water spinach, leaf mustard and fruit vegetables such as yard-long beans, are grown in the warm, rainy summer months. However, some crops are grown throughout the year, e.g., flowering white cabbage and lettuce. Market prices also affect the choice of crops grown at particular times and hence affect crop rotations. The farmers visited rarely plant the same vegetable crops in immediate succession.

Wong (1971: 174) observed that farmers with relatively small farms did not follow systematic crop rotations. On some farms flowering white cabbage or watercress had been grown continuously for many years. However, farmers with relatively large farms did follow crop rotations. They recognized that rotation helps to control some pests and diseases and may make better use of plant nutrients. He further observed (p. 175) that some farmers grew a crop of rice once every 3-4 years in rotation with vegetables, in order to reduce toxic residues accumulated from continuous vegetable cultivation and to improve soil conditions.

Field and bed layouts

The fields of all the farms visited are terraced and levelled, most of them having been used in the past for wetland rice production. The fields would also have been bunded in the past for wetland rice cultivation but, at present, most of the field bunds have more or less disappeared, except on two of the farms in low-lying areas, as rice is no longer grown at all on these farms.

Two kinds of raised beds were seen on the 7 farms visited. In areas with good natural drainage, low raised beds are constructed with footpaths between them to provide access to crop plants and adequate drainage. Bed dimensions vary from farm to farm, particularly in length. When measured from centre to centre, i.e., including half of the footpath around each bed, the typical dimensions are as follows: width 1.0-1.5m; height 0.10-0.15m for shallow rooted crops, e.g., flowering white cabbage, to 0.5m for deeper rooted crops, e.g., yard-long beans; length 12-24m, depending on the shape of the field and convenience for bucket watering. On some farms, where bucket watering is carried out, the edges of the beds are slightly raised so as to form low rims, which help to retain irrigation water during and immediately after application.

In other areas, usually with poor natural drainage, but also occasionally on terraced fields, high raised beds are constructed with ditches between them. These are very similar to the same kinds of beds observed in Canton and described in Chapter 1. When measured from centre to centre the dimensions of the beds on the two farms where they were seen were as follows: width 1.5m, or 2.9m where a double kind of bed is constructed with alternate footpaths and ditches between beds; height 0.5m; and length 15-30m.

With both kinds of raised bed, the alignment of the beds appears to be determined principally by the shape of the field. As the fields on all the farms visited are terraced, originally for rice farming, they are flat, and hence there is no need to align beds along the contour in order to prevent soil erosion. However, the fields are small and usually irregular in shape. Hence, the beds are aligned along the length of the fields in order to maximise their length. They are often slightly curved in order to fit into the irregular field shapes.

Wong (1971: 117) reported low raised bed dimensions as follows: width (excluding footpaths) 0.9-1.2m, with footpaths about 0.3m wide between them, height 0.1m and length variable according to the size of the field. He further reported (p.118) high raised bed dimensions as follows: width (excluding ditches) 1.8-2.0m, with ditches about 0.4-0.5m wide between them, height 0.4-0.5m and length unspecified. The ditches allowed the use of small boats, about 1.5 long, in a way similar to wheelbarrows, as in Canton.

Cultivations

The implements used for land preparation are mechanical cultivators and hoes. 6 of the 7 farmers visited own small, single-axle, mechanical cultivators (rotary cultivators), 3-6 HP in size. The mechanical cultivators have largely replaced the hoes for turning over the soil in the beds. The hoes are still used though for shaping and levelling the beds after rotary cultivation. However, one farmer, who constructs high raised beds, still uses the hoe for all cultivations including changing the positions of the beds and ditches once every 3 years. Another farmer, with the same kind of high raised beds, used the hoe for the initial breaking up of the soil and followed this with rotary cultivation to create a fine tilth. In this case, using the hoe initially made it easier to prevent the soil falling into the ditches.

Wong reported (1971: 168) that at the time of his observations land preparation was carried out, immediately after harvest of the previous crop, by either animal ploughing or hand digging (hoeing). Small rotary cultivators were only used by some farmers. Ng (1965: 107) reported that in Tung Chung land preparation was carried out manually or sometimes with ox-drawn ploughs and harrows borrowed from rice cultivators.

Mulching

Mulching of vegetable crops is not practised by any of the 7 farmers visited. However, Wong (1971: 167) reported that sown seed beds were mulched with a layer of rice straw or dried grass to conserve soil moisture and to prevent the eating of seed by birds. The cover of straw or grass was removed after germination. He also reported (p.170) that mulches of materials such as straw, dry leaves and duck feathers were generally used on many vegetable crops to reduce weed growth, conserve moisture, keep soil cool and reduce erosion, although few farmers used mulches on flowering white cabbage.

Overhead protection of seed beds

Wong (1971: 167) reported that under wet conditions, covers raised about one metre above the ground were used to protect seedlings. The covers were made of polythene, rice straw or corrugated iron.

Trellising

Those farmers who grow climbing fruit vegetables, e.g., yard-long beans, construct bamboo trellises to support the crops.

Organic fertilizers, materials and preparation

Six different kinds of organic fertilizers are used on the 7 farms visited. The more important ones are peanut cake (peanuts after oil extraction), bonemeal, dried sharks' fins and chicken manure. On one farm a little pig manure and nightsoil is also used. Peanut cake and bonemeal are bought from dealers. Dried sharks' fins are bought through a farmers cooperative. Chicken manure is either bought from other farmers or, in one case, obtained on the farm itself. Similarly, on the one farm where pig manure and nightsoil are used, they are also obtained on the farm itself.

Prior to application, peanut cake and bonemeal are normally not given any special preparation but are applied in dry form. However, one farmer does ferment peanut cake in large jars for a period of one month. The fermented peanut cake is then mixed with water in a sump and applied by bucket watering. This is done especially for closely spaced crops. Similarly, dried sharks' fins are also fermented in water in sumps for periods of 1-4 weeks. After fermentation the liquid fermented sharks' fins are transferred to storage jars situated beside other sumps at strategic points around the farm, prior to mixing with water and application with buckets. Chicken manure is also fermented in water in a water sump for 3-4 days prior to application on one farm.

Wong (1971: 85) reported that nightsoil, in small quantities, peanut cake, animal manure and compost were used as organic fertilizers on the vegetable farms in the New Territories, at the time of his study. Nightsoil had previously been supplied to farmers by the Government and later by the Vegetable Marketing Organisation (VMO) up until 1969. It had been fermented in maturation tanks prior to distribution to farmers. He stated that farmers reported it was a very good fertilizer, particularly for the growing of leafy vegetables. However, owing to the increasing provision of water-borne sewage systems in the urban areas, supplies of nightsoil had diminished in recent years. Also rising labour costs had discouraged farmers from handling such a bulky fertilizer. Hence, at the time of his study, farmers could only use a small quantity of nightsoil collected around their farms.

Ng (1965: 102) reported that, at the time of his study, in the Tung Chung area of Lantau Island poultry manure was the most popular organic fertilizer used. He also observed that nightsoil was seldom used (p.102).

However, some years earlier, Tregear (1958: 27) reported that the New Territories farmer, like his forebears of forty centuries, relied mainly on matured nightsoil for the maintenance of the fertility of his fields. He added (p.38) that ash, bone meal and duck feathers were also used. He commented (p.40) that on vegetable farms located on the decomposed granite hill top soils, the "soil" was used as a medium for fixing the plant, the nutrient being the constant top dressing of nightsoil.

After a walk around Happy Valley in Hong Kong Island, King (1911: 68) commented that everything that could possibly serve as fertilizer for the soil, or food for the crop being grown, was used as such unless there was some more remunerative service it could render. He observed that nightsoil, manure and ashes were all used as fertilizer. These were often applied in liquid form after dilution with water.

Organic fertilizers: application rates

The application rates, reported by the farmers, expressed in metric units on a dry weight basis, are as follows: peanut cake or bonemeal alone 0.4-0.9 t/ha/crop; peanut cake and bonemeal together 2.0-2.2 t/ha/crop; sharks' fins alone 1.4-2.3 t/ha/crop. A scrambled average for these three different kinds of fertilizer would be about 1.5 t/ha/crop for all crops, most of which are short duration leafy vegetables, but the meaningfulness of such an average figure for different kinds of fertilizer is limited. Nevertheless, based on the average number of crops grown per year on the different farms of 8.2, the annual application rate amounts to an average of some 12 t/ha/year, for these particular fertilizers. No data were provided on chicken manure application rates.

Wong (1971: 169) reported that where nightsoil was used alone as an organic fertilizer it was applied at a rate of 22.5 t/ha/crop (viz., 25 piculs per dau chung per crop).

Organic fertilizers: application timing and placement

Dry peanut cake and bonemeal are applied once per crop either before planting as a basal dressing or in the early growth stages. Liquid fermented sharks' fins are applied 4-5 times per crop and liquid fermented chicken manure is applied once every 2 days, both liquid manures being applied as top dressings by bucket watering.

Wong (1971: 85) reported that when nightsoil was applied as a fertilizer it was diluted, after maturation, and applied as a liquid top dressing every 2-4 days during the crop growing period, or every 4-5 days (p.170). Ng (1965: 102) reported that chicken manure was often used as a basal dressing.

Chemical fertilizers

All 7 farmers interviewed apply chemical fertilizers, the most popular kind being Nitrophoska in either "Red" or "Blue" form. Nitrophoska Blue is a compound fertilizer with a formula of, N: 12%, P_2O_5: 12%, K_2O: 17% and MgO: 2%. Nitrophoska Red is the same but without the 2% MgO. One farmer also uses a small amount of ammonium sulphate when he observes yellowing of crop leaves.

Information provided by 4 of the 7 farmers indicates application rates varying from 0.63-0.94 t/ha/crop, with an average of 0.77 t/ha/crop. Annual application rates, based on the numbers of crops grown per year on the different farms, range from 3.8-9.3 t/ha/year, with an average of 5.7 t/ha/year.

The timing of application varies considerably between the different farms and crops grown from 1-3 times per crop to as frequently as once every 3-7 days. Chemical fertilizers are applied as top dressings and not as basal dressings. They are either applied with organic fertilizers by bucket watering, or they are applied in dry form by hand.

Wong (1971: 169) also observed that Nitrophoska was the most commonly used chemical fertilizer. It was either diluted and applied as a liquid or it was applied in dry form in bands between the crop rows. It was applied at a rate of 1.35 t/ha/crop (viz., 1.5 piculs per dau chung), when applied alone. Ng (1965: 102) also reported the use of chemical fertilizers as top dressings. Some years earlier, Tregear (1958: 28) commented that chemical fertilizers (ammonium sulphate, superphosphate and sulphate of potash) were increasingly used but the high cost of these was usually prohibitive to the small farmer.

All 7 farmers interviewed regularly apply lime to crop beds before planting. An application rate was obtained from one farmer who estimated it to be 1.35 t/ha/application, applied once per crop or once per two crops. Based on his reported cropping intensity of 6-7 crops per year, his total lime application is of the order of 5-10 t/ha/year. Other farmers reported applying lime just as frequently, at around once per 1-2 crops, but some farmers only apply lime around once per 4-6 crops. Two farmers reported applying lime in order to kill insect pests.

Irrigation

Both streams and groundwater are used to provide irrigation water for vegetable crops. Where farms are located near to streams, water is extracted from the streams by small diversion weirs and is distributed by gravity flow to the farms through earth or concrete lined channels, or in some cases through galvanized iron (G.I.) pipelines. Where groundwater is available, wells, usually fitted with electric pumps, provide water for irrigation; this is the case on 4 of the 7 farms.

On 3 of the 5 farms with low raised beds the sump and bucket method of irrigation is used. On the other 2 farms with low raised beds, sprinkler irrigation systems have been installed, one a solid set rotary head sprinkler system and the other a solid set fixed head sprinkler system. On the other 2 farms, with high raised beds, the ditch (deep furrow) and scoop method of irrigation is used. Depending on the weather water is applied by bucket or scoop 1-3 times per day and up to 4 times per day on one of the farms with sprinkler irrigation.

Wong (1971: 117) reported that there were three common methods of irrigation in Hong Kong, namely bucket irrigation, furrow (ditch and scoop) irrigation and flooding (basin irrigation), the latter being used for aquatic crops such as water spinach and watercress. At the time of his observations, sprinkler irrigation was only being introduced. There had been, however, a tendency to replace the traditional water lifting devices, e.g., counterpoise, swing bucket and water ladder (dragon bone pump) with motorized centrifugal pumps (p.126). He also reported (p.169) that watering was carried out 2-4 times per day, except on rainy days, for newly transplanted crops. Watering was reduced to once a day when the plants grew bigger. Ng (1965: 107) reported that the sump and bucket method of irrigation was used in Tung Chung. Watering was carried out once or twice a day according to season (p.108).

Drainage

On the 5 farms with low raised beds excess rain water runs off along the footpaths between the beds and into open earth drains or stream courses. On the two farms with high raised beds the ditches between the beds serve as drains.

Weeds and weed control

On all the farms visited, the fields and crop beds appear clean weeded. Most crop beds are hand weeded during crop growth. On 4 of the 7 farms visited a herbicide, usually paraquat but in one case nitrofen, is occasionally applied after harvest to kill off weeds if they have become a problem. When herbicides are applied farmers sometimes use a portable flame thrower a few days later to burn off weeds killed by the herbicide treatment.

Wong (1971: 170) reported that weeding was carried out by cultivation (hoeing), by hand (i.e. by hand pulling) and by mulching. At the time of his observations, herbicides were not used. Similarly, Ng (1965: 107) also observed that herbicides were not used.

Pests and pest control

Diamond back moth and flea beetle were reported to be insect pests. The Giant African Snail was also mentioned as a pest. The farmers reported using insecticides, including Atropine (?), Dimethyl(?), Dynacide (?) and Malix (?). Insecticide spraying frequencies varied from 2-3 times per crop to once per week. Traditional natural plant extracts are not used as insecticides by any of the farmers. However, 2 farmers reported that they do use lime to control insect pests and one of these also reported that he applies wood ashes to beds of growing crops to kill insects. Baits containing poisons are used for the control of Giant African Snail.

Wong (1971: 171) reported that there were many kinds of insects which cause damage to vegetables. The following were commonly found on flowering white cabbage: **Plutella xylostella** (diamond back moth), **Phyllotreta striolata** (flea beetle), **Lipaphis erysimi** (brassica aphis), **Trichoplusia brassicae** (cabbage looper) and **Hellula undalis** (cabbage webworm). These insects were said to be more active in warm weather than in the cool season. He also reported (p.172) that farmers used insecticides, in a "cocktail mixture", to control insect pests, as well as good farm practices. The latter included: removing trash (crop residues) and weeds, keeping growing crops in vigorous condition, though planting at the right season, adequate fertilization and judicial irrigation, planting resistant varieties and rotating crops. Ng (1965: 108) also observed that farmers used modern insecticides, which have replaced the use of derris and the picking off of insects by hand (p.115).

Diseases and disease control

Little information was obtained on this. However, of the 2 farmers asked both reported that they did not use fungicides.

Wong (1971: 172) observed that farmers paid little attention to disease control, partly because they lacked knowledge in recognizing disease damage and partly because they considered that no control measures were required for the crops they grew, e.g., flowering white cabbage. However, he stated that some diseases could cause considerable damage to vegetable crops, e.g., Fusarium wilt of cucurbits and tomatoes, rust of Chinese chives and downy mildew of

Chinese kale. Although little use was made of fungicides, efficient farmers used a number of practices to control diseases, including: control of weeds, keeping crop plants in vigorous condition, control of insects, particularly aphids carrying viruses, selecting disease resistant varieties, rotation of crops, provision of good drainage, sowing thinly in seed beds, burning or burying all plants showing virus diseases, keeping plants properly thinned and disinfection of seed and soils.

Harvesting and packing

Vegetables are harvested by hand. Most leafy vegetables are cut, e.g., flowering white cabbage, Chinese kale, leaf mustard, lettuce, Chinese box thorn and Chinese chives. Others are pulled up with their roots on, e.g., Chinese spinach, water spinach, garland chrysanthemum and spring onions. Fruit vegetables, e.g., yard-long beans and eggplant, are picked. The harvesting of some vegetable crops may extend over a considerable period of time, e.g., Chinese kale 50 days and Chinese spinach 30 days; in these cases after initial cutting the crop plants are allowed to regrow for further harvests.

Before packing vegetables may or may not be washed. Of the farmers visited, half reported that they washed the vegetables before packing and marketing. Most farmers now use plastic crates instead of the traditional bamboo baskets for packing vegetables. This change has been brought about by the Vegetable Marketing Organisation (VMO).

CROP YIELDS

Yield per crop

Yield data reported by the 7 farmers are given in Table 2.5. Comparable information reported by previous writers is also given in Table 2.5.

No information was obtained concerning the yield variation between interplanted crops and crops grown as pure stands. However, information was obtained concerning the yield variation between the same crops grown in both the cool, dry winter season and the warm, rainy summer season. The yields of flowering white cabbage, lettuce and garland chrysanthemum were reported to be around 50-100% higher in the cool, dry winter season than in the warm, rainy summer season.

Annual yield

No information was obtained on this from the farmers interviewed.

LABOUR USE

Labour used per hectare

The estimated amount of labour used on the 7 farms visited, based on full-time labour equivalents (see Appendix C) ranges from 2.2-6.3 persons/ha, with an average of 4.5 persons/ha.

Farm labour is almost entirely provided by the farm family. Hired labour is seldom used It is used just occasionally on 2 of the 7 farms, on a part-time basis for transplanting and harvesting, and has therefore been omitted from the estimate of labour used.

Table 2.5 Vegetable crop yields, Hong Kong.

Crop	No of samples (1)	Yield per crop, range, t/ha/crop (1)	average, t/ha/crop (1)	Yield per crop, range, t/ha/crop (2)	average, t/ha/crop (2)	Yield per crop, range, t/ha/crop (3)	average, t/ha/crop (3)
Flowering white cabbage	7	3.6-25.2	12.5	10.6-13.3	12.0		18.9
Chinese white cabbage	1	18.0	18.0	16.4-20.6	18.5	10.8-22.5	16.7
Chinese kale	4	9.0-36.0	17.4		21.2		22.5
Leaf mustard	2	2.7-19.8	11.3		11.3	16.2-30.6	23.4
Chinese spinach	3	3.6-18.0	11.7		9.0		
Lettuce	4	13.5-36.0	23.8		21.0		19.8
Water spinach (dry bed)	1	7.2-10.8	9.0				
Spinach	3	22.5-27.0	24.0				
Garland chrysanthemum	2	1.8-18.0	10.1				
Coriander	2	2.7- 7.2	4.1				
Chinese box thorn (per cut)	1	13.5	13.5				
Chinese chives (per cut)	2	14.4-18.0	16.2				
Yard-long beans	2	7.2-13.5	10.8		10.9		10.8
Eggplant	1	2.7- 3.6	3.2		42.3		
Shallots/spring onions	2	4.5-18.0	11.3		11.2		

Sources: 1. Fieldwork, 1981.

2. Hong Kong Agriculture and Fisheries Department (1982), unpublished data.

3. Ng (1965: 110).

Labour used per hectare per crop

Based on the numbers of crops grown per year, on 6 of the 7 farms visited where data were made available, the labour used ranges from 0.5-0.8 persons/ha/crop with an average of 0.6 persons/ha/crop.

Terraced fields on sloping land

Seed beds and field beds (flowering white cabbage)

Staggered sowing dates (Chinese spinach)

Vegetable farming in Hong Kong

Plate 2.1

High raised beds and ditches. Lime applied during land preparation

Land preparation with hoe

Interplanting (Chinese box thorn with leaf mustard)

Vegetable farming in Hong Kong Plate 2.2

Water and manure sumps

Filling buckets with water and liquid manure

Applying water and liquid manure

Vegetable farming in Hong Kong

Plate 2.3

Sprinkler irrigation system

Clean weeded field beds

Harvesting (flowering white cabbage)

Vegetable farming in Hong Kong

Plate 2.4

CONCLUSION

The data presented in this chapter are supplementary to those presented in Chapter 1 in forming a baseline of information on the use of traditional Chinese vegetable farming practices in South China. In addition, the data in this chapter provide further information on the use of modern Western practices in vegetable farming in South China. Analyses of these data will be presented in Chapters 7 and 8, after presentation of the case studies on the use of Chinese vegetable farming practices in Southeast Asia. However, before the case studies are presented, more background information on Southeast Asian vegetable farming environments is required. This is presented in Chapter 3.

CHAPTER 3

CHINESE VEGETABLE FARMING IN SOUTHEAST ASIA: BACKGROUND AND ENVIRONMENTS

INTRODUCTION

This chapter focuses on the background to and environments of Chinese vegetable farming in Southeast Asia. Background information is presented on the migration of Chinese people to Southeast Asia and on the location of Chinese vegetable farming areas in Southeast Asia. Also, detailed information is presented on the physical and human environments of the Chinese vegetable farming areas in Southeast Asia selected for case study.

MIGRATION OF CHINESE TO SOUTHEAST ASIA

Origins in China

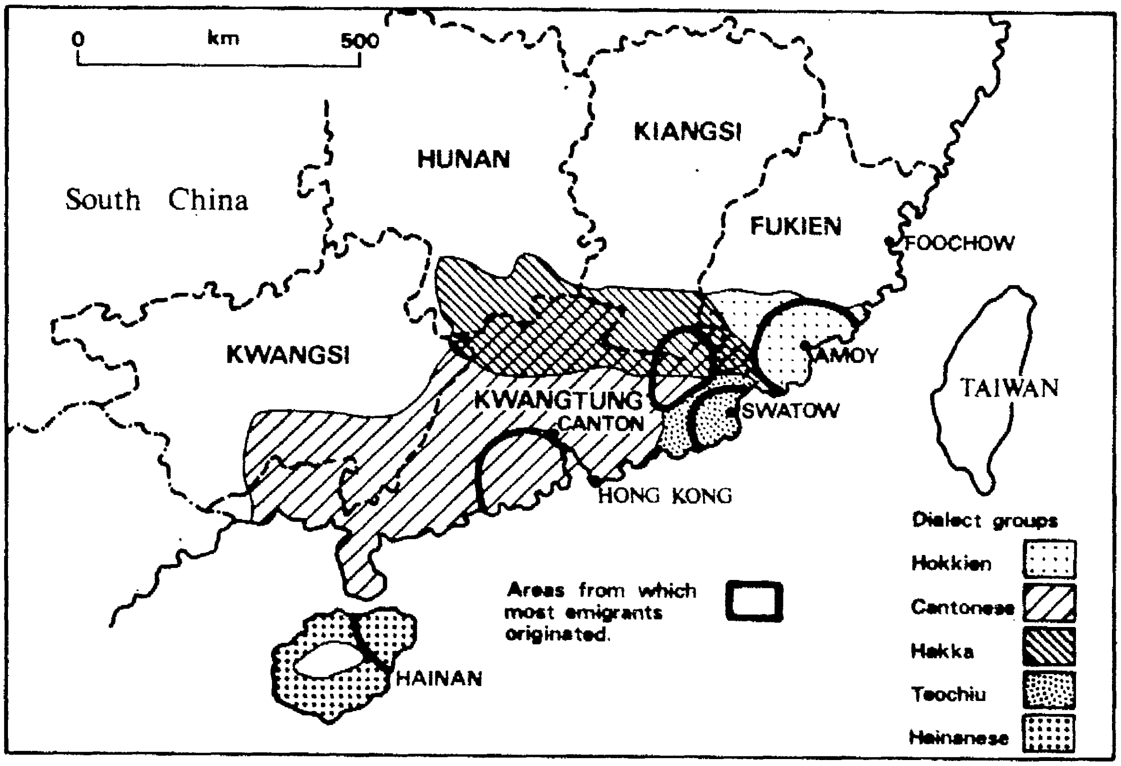
Migration of Chinese people to Southeast Asia has been taking place for many centuries, although it only reached significant proportions during the Ming Dynasty (1368-1644). Many of the early migrants were traders. However, during the nineteenth and early twentieth centuries very large numbers of poor rural Chinese also migrated. Nearly all of the migrants originated from the two coastal provinces of South China, Kwangtung (Guangdong) and Fukien (Fujian). Very few originated from other provinces of South China and virtually none from the provinces of North China. They consisted of a number of different dialect groups, i.e., tribal or speech groups, including primarily, Hokkien, Cantonese, Hakka, Teochiu and Hainanese. Members of these different groups speak mutually unintelligible dialects of Chinese, although they do share a common written form of Chinese (Purcell, 1965: 24, and Heidhues, 1974: 4). The places of origin of the 5 major dialect groups are shown in Figure 3.1.

Several motivating factors have been identified which collectively encouraged the Chinese to migrate from Kwangtung and Fukien. Purcell (1965: 24) considered that the migration was mainly due to population pressure in these provinces and to their contiguity with Southeast Asia. Migration was accentuated by internal troubles in China, especially civil strife, and also encouraged by contacts with Europeans, particularly in Canton and Amoy, which were the principal trading ports. Heidhues (1974: 6) put forward similar reasons and considered that emigration naturally followed the trading routes, when news of economic opportunities in Southeast Asia, the "Nanyang", made itself felt among the Chinese living in the vicinity of the trading ports.

Of the Chinese who migrated to Southeast Asia, not all settled permanently. Many returned to China after some years. Finally, after the Second World War, the migration virtually came to an end, with the imposition of strict controls (Purcell, 1965: 30). Hence, of the Chinese now living in Southeast Asia, over half were born there. Those, mainly older Chinese, who were born in China have now been resident in Southeast Asia for several decades (Heidhues, 1974: 1). It has been estimated recently (Coppel, et al. 1982: 3) that 85% of the Chinese living in Malaysia, Indonesia and the Philippines today were locally-born in those countries.

Distribution in Southeast Asia

With the widespread intermarriage between immigrant Chinese and indigenous local people in Southeast Asia, which occurred largely



Source: Heidhues (1974:1)

Notes : (a) Hakkas sometimes live in areas inhabited primarily by other dialect groups

(b) This map shows places of origin of major dialect groups only.

Figure 3.1 Places of origin in China of Chinese in Southeast Asia.

because of local shortages of Chinese women, it has become difficult to distinguish clearly just who is Chinese and who is not. Both Purcell (1965: 1) and Heidhues (1974: 3) define in very similar ways a concept of "ethnic" Chinese in Southeast Asia. The concept is that ethnic Chinese are those Chinese who regard themselves, or are so regarded by others, as Chinese in a broad or cultural sense, but are citizens of the Southeast Asian country they inhabit. They may not necessarily be persons actually holding Chinese citizenship, i.e., Chinese nationals.

Ethnic Chinese, today, are widely distributed throughout Southeast Asia, as is shown in Table 3.1. The table summarises information, derived from Heidhues (1974: 4-6), on the place of origin of the 5 most numerically important Chinese dialect groups and the present distribution of these groups in Southeast Asia.

An attempt to quantify this distribution of ethnic Chinese over the last 50 years, is made in Table 3.2, which is based on information from Purcell (1965: 3), Heidhues (1974: 3) and Coppel et al. (1982: 3), tabulated on a common country by country format. This table shows that the largest numbers of ethnic Chinese live in Thailand, Malaysia (West and East) and Indonesia, more moderate numbers live in Vietnam and Singapore, smaller numbers live in Burma, Cambodia and the Philippines, and much smaller numbers live in Laos and Brunei. However, the countries with the highest percentages of ethnic Chinese in their populations are Singapore, Malaysia (West and East), Brunei and to a lesser extent, Thailand. Overall, about 5% of the total population of Southeast Asia may be considered to be ethnic Chinese, viz., some 15 million out of 278 million, on the basis of 1970 figures. Figure 3.2 illustrates the distribution of ethnic Chinese in Southeast Asia.

Table 3.1 Origin and distribution of Chinese in Southeast Asia, by dialect groups.

Dialect group	Place of origin in China	Distribution in Southeast Asia
Hokkien	Vicinity of Amoy, Fukien Province	Penang and Malacca, W. Malaysia (1) Java, Indonesia (1) Philippines (1) S. Vietnam Cambodia
Teochiu	Near Swatow, Kwangtung Province	Thailand, especially Bangkok (1) Sumatra, Indonesia (1) Cambodia (1) S. Vietnam (2) W. Kalimantan, Indonesia (2) Java, Indonesia (3)
Hakka	Kwangtung and Fukien Provinces	W. Kalimantan, Indonesia (1) Sabah, E. Malaysia (1) W. Malaysia (2) Java, Indonesia (2)
Cantonese	Countryside around city of Canton, Kwangtung Province	S. Vietnam (1) W. Malaysia, outside Penang and Malacca (1) Cambodia (2)
Hainanese	Hainan Island, Kwangtung Province	Singapore Thailand S. Vietnam Cambodia

Source: Derived from Heidhues (1974: 4-6).

Note: In this table, the numbers or indices, labelling the specified locations where different dialect groups are distributed, represent the numerical importance of each dialect group in each location, i.e., (1) = largest dialect group in the location, (2) = second largest, and (3) = third largest.

Table 3.2 Distribution of ethnic Chinese in Southeast Asia, by countries.

Country	Numbers of ethnic Chinese, in thousands c.1931 (1)	1947 (1)	1960 (1)	1970 (2)	1981 (3)	Ethnic Chinese as % of total population in country, 1970 (2)
Burma	194	300	350	440	No data	1.6
Thailand	445	2,500	2,670	3,400	- " -	10.0
Vietnam (a)	)	)	855	1,408	- " -	3.6
Cambodia	) 418	) 850	350	435	- " -	6.4
Laos	)	)	35	58	- " -	2.0
Singapore	)	)	1,231	1,500	- " -	74.5
	) 1,704	) 2,615				
W.Malaysia	)	)	2,552	3,250	4,103	36.1
E.Malaysia (b)	)	)	341	455	713	28.1
	) No data	) 220				
Brunei	)	)	22	32	No data	27.6
Indonesia (c)	1,233	1,900	2,695	3,106	3,922	2.6
Philippines	72	120	182	520	692	1.4
Total	-	8,505	11,283	14,604	-	
Ethnic Chinese as % of total population in Southeast Asia	-	5.4	5.2	5.3	-	

Sources: 1. Purcell (1965: 3).

2. Heidhues (1974: 3).

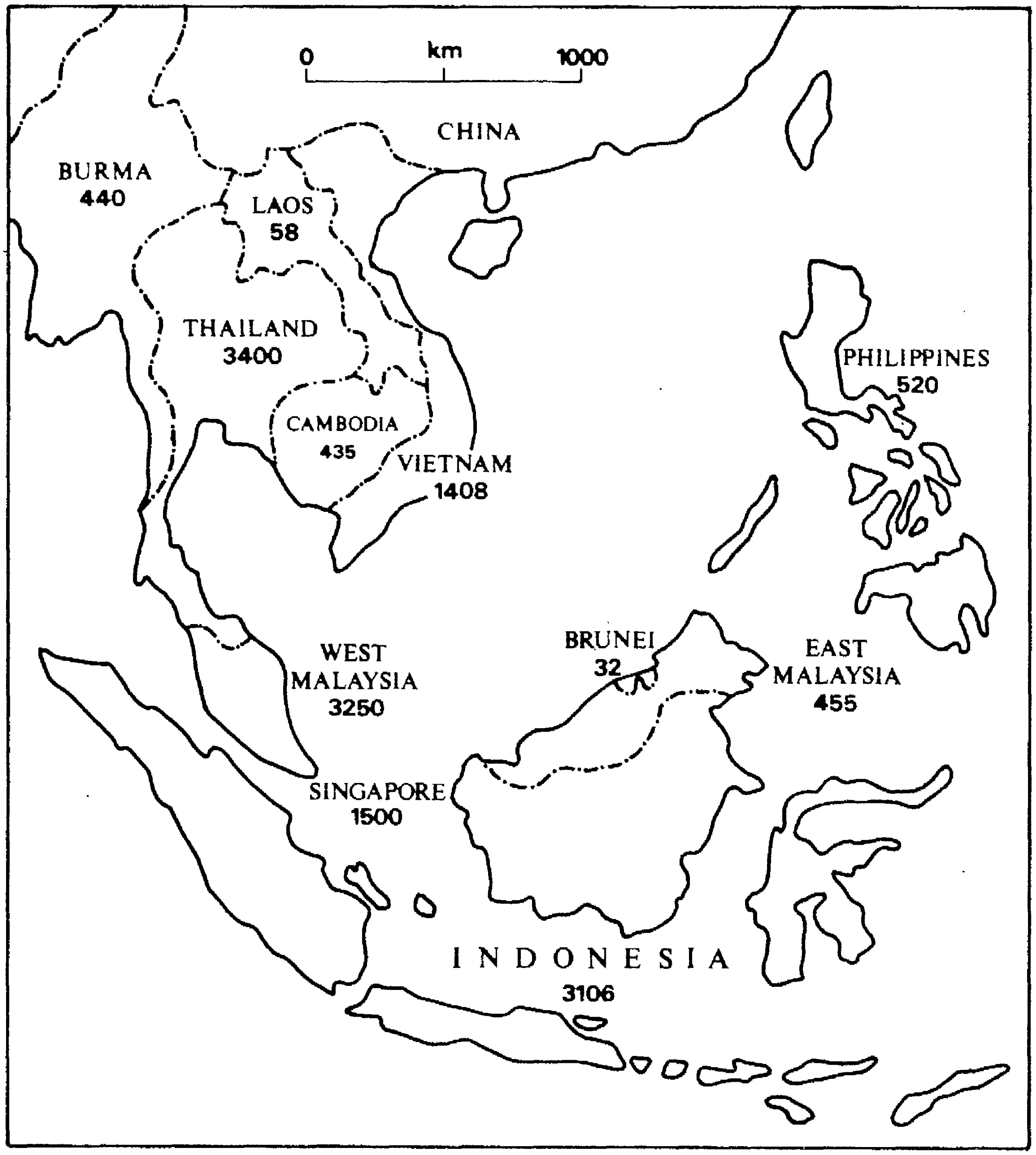
3. Coppel et al. (1982: 3).

Notes: (a) Vietnam figures include N. and S. Vietnam.

(b) E. Malaysia figures include Sarawak and Sabah.

(c) Indonesia figures include Indonesia and Portuguese Timor.

(d) Total population in Southeast Asia in 1970 was 277,981,000; a figure derived from Heidhues (1974: 3). Of this figure, approximately, 5.3% were ethnic Chinese.



Source: Derived from Heidhues (1974:3).

Notes : (a) Figures are expressed in thousands.

(b) Figures are for an estimate dated 1970

(c) Heidhues's figures for Indonesia and Portuguese Timor have been added together. Similarly, figures for North and South Vietnam have been added together.

Figure 3.2 Distribution of ethnic Chinese in Southeast Asia.

Williams (1966: 10) pointed out that Chinese settlers are most numerous in those parts of Southeast Asia where economic development has created a need for their energies and an opportunity for the application of their talents, and where administrative policies on immigration have been hospitable. This latter condition, of course, does not apply to the present time but, rather, to the colonial period. Williams went on to say (p.12) that the massive concentrations of overseas Chinese are to be found, today, in the great cities, e.g., Singapore, Jakarta, Saigon (Ho Chi Minh City), Bangkok and Manila and in countless smaller places, or towns. Other areas of thick Chinese settlement are found in the tin-mining districts of West Malaysia and the rubber estate areas of Malaysia and Indonesia. He also pointed out that Chinese peasants, or small farmers, are established in numbers in places where there is a demand for their specialization in the raising of garden vegetables, pigs and poultry. He noted the existence of Chinese market gardens around cities, e.g., in Thailand and Malaysia.

The Chinese in Southeast Asia are engaged in a variety of economic activities or occupations. These include: trade, or commerce, the principal occupation, e.g., money-lending, big business, and the small retail shop; labouring, e.g., longshoremen and pedicab drivers; agriculture, e.g., both large estates and small farms, and trading in agricultural produce; tin mining; restaurants; and, to a small but increasing extent, professional occupations, e.g., lawyers and doctors, but rarely government service (Heidhues, 1974: 8-18).

Williams (1966: 13) estimated that Chinese peasant (small holder) farmers probably represent no more than 5 per cent of the total overseas Chinese population in Southeast Asia. Heidhues (1974: 17) considered that the comparatively low number of farmers is due to legal restrictions placed on Chinese immigrants which prevented them from acquiring farm land in most Southeast Asian countries and in some countries limited their settlement to urban areas, and also to a preference of the Chinese for commercial activities.

LOCATIONS OF CHINESE VEGETABLE FARMING AREAS IN SOUTHEAST ASIA

Heidhues (1974: 10,18) reported a number of locations where Chinese immigrants became small-holder farmers in Southeast Asia during the nineteenth and early twentieth centuries. The Chinese were vegetable gardeners around Bangkok in Thailand; pepper growers in Cambodia; pig, vegetable and fruit farmers in Malaya; rubber producers in Borneo; vegetable, pepper and gambier producers in Singapore; and sugar growers at Batavia (Jakarta) in Java. Chinese were also involved in market gardening in Manila in the Philippines (Wernstedt and Spencer, 1967: 127,183). However, detailed historical reports relating to the location of Chinese vegetable farming areas are hard to find, but some are presented below.

Regarding Thailand, Skinner (1957: 15) reported that Chinese pig farmers, and probably vegetable gardeners, were present at Ayutthaya, the former capital of Thailand which is located near Bangkok, during the seventeenth century. By early in the nineteenth century, Chinese had settled in considerable numbers in certain rural areas of South-east, Lower and Southwest Siam. They married Thai women and to a large extent recreated peasant life in South China. They grew rice, tobacco, pepper, sugar cane, seri leaf, fruits and vegetables. Those located near population centres soon specialized in the production of seri leaf and vegetables for local markets (p.111).

During the nineteenth century, a zone of vegetable gardens, seri leaf and betel nut groves, and pig farms, developed around Bangkok and other important towns. This zone grew more extensive with the passage of time. Skinner (p.113) quotes a description by Bradley of the Chinese gardens near the river at Bangkok in 1836,

"The gardens are cultivated very neatly. They may not be termed tasteful but rich. ... beds of peas, ... lettuce, onions, radishes, turnips, sera-leaf and betel occupy large portions of their gardens. The gardeners live in small dirty huts within their premises guarded by a multitude of dogs, and a horrible stench of pigsties".

The Chinese used liquid manure for the vegetables and decayed fish to fertilize the seri vines. They continually watered the crops by hand from the small ditches laid out between the raised planted strips. Pig breeding was usually carried out in conjunction with gardening, so as to utilize both manure and waste vegetable matter.

By 1910, vegetable and seri leaf farming and pig raising gave employment to several thousand Chinese in the vicinity of Bangkok (p.113). The majority of the farmers were Teochiu, with Hokkiens in second place. Some Hainanese were also market gardeners (p.136). During the early part of the twentieth century, up to 1938, market gardening remained in Chinese hands and continued to expand to meet the demands of the ever increasing urban population (p.217).

Further information about Chinese vegetable farming areas in Thailand has been provided by Boonma et al (1974: 13), who believed that Chinese immigrants have been engaged in vegetable farming in Damnoen Saduak since around 1900 or before. This area is about 75 km west of Bangkok, in the lower part of the Chao Phraya river delta. The Chinese farmers settled there because of the good drainage system with many canals and because there was already a settlement of other Chinese immigrants nearby.

Boonma and Welsch (1973: 6-7) reported that in recent years seasonal flooding in this area, which is only 1-2 m above sea level, has been getting worse, as a result of increased irrigation and improved drainage in areas upstream. Also, vegetable pest and disease problems have been getting worse. These writers reported that many of the present farmers in this area wish they could abandon their land and move to a new area. In fact, some farmers from Damnoen Saduak have migrated in the past to areas closer to Bangkok, e.g., Talingchan, which is on the west bank of the Chao Phraya river and is part of the Bangkok metropolitan area.

Sritunya (1975: 15) reported that all the vegetable farmers at Talingchan, and a neighbouring district Phasrichareon, are now Thais, who were previously employed by Chinese landlords on adjacent farms. Having learned from the Chinese how to grow vegetables, the Thais have started their own farms.

Regarding Malaysia, Ooi (1976: 217) reported that there were Chinese market gardeners in Malacca as early as the mid-seventeenth century. Their number increased greatly during the initial phase of Peninsular Malaysia's economic development when large numbers of immigrants entered the country and the demand for food increased correspondingly. There were 50,000 market gardeners in 1931; by 1947 their numbers had increased to 86,000, mainly as a result of the Japanese occupation when thousands of Chinese 'returned to the land' to grow their own food. But the disruption created by the resettlement campaign caused their numbers to fall to 38,700 in 1957.

Regarding the Philippines, Wernstedt and Spencer (1967: 183) commented that market gardening is quite recent in (Philippine) island agriculture and often is confined to fringes of urban areas containing significant numbers of Chinese. They reported that the region around Manila Bay became the entering wedge for the Chinese element in Philippine culture and that the Chinese modified tools, handicraft technology, market-gardening technology and crop plants, and significant portions of the urban domestic dietary (p. 127).

In this study, 6 Chinese vegetable farming areas in Southeast Asia have been selected for detailed case study. These are Bangkok in Thailand, Lim Chu Kang in Singapore, Cameron Highlands in Malaysia, and Manila, Cebu and Baguio in the Philippines. The criteria used in the selection of these areas were set out in the Introduction. Details concerning the precise locations of farms visited in the case study areas are given in Table 3.3. and Figure 3.3.

PHYSICAL ENVIRONMENTS OF CASE STUDY AREAS

Information gathered on the relief, natural drainage, climate and soils of the case study areas is presented in tabular form in Tables 3.4 - 3.8.

HUMAN ENVIRONMENTS OF CASE STUDY AREAS

Information gathered on the markets, farming structure, farm labour supply and farm input supply of the case study areas is presented in tabular form in Tables 3.9 - 3.12.

Table 3.3 Location of case study areas in Southeast Asia.

Country	Case study area	District of farms visited	Location of districts relative to urban areas
Thailand	Bangkok	Phasichareon) Talingchan)	On western edge of city of Bangkok
		Muang	Near to northern edge of city of Bangkok
Singapore	Singapore	Lim Chu Kang	In northwestern part of Singapore Island, near to urban area
Malaysia	Cameron Highlands	Brinchang) Ringlet)	In mountains, far from any urban areas
Philippines	Manila	Pasay	In southern part of Metro Manila, near airport
		Santa Rosa, Laguna	Near southern edge of Metro Manila
Philippines	Cebu	Talisay	Near southwestern edge of Metro Cebu
Philippines	Baguio	La Trinidad	On northern edge of Baguio City
		Madayman	Along Mountain Trail, above Baguio

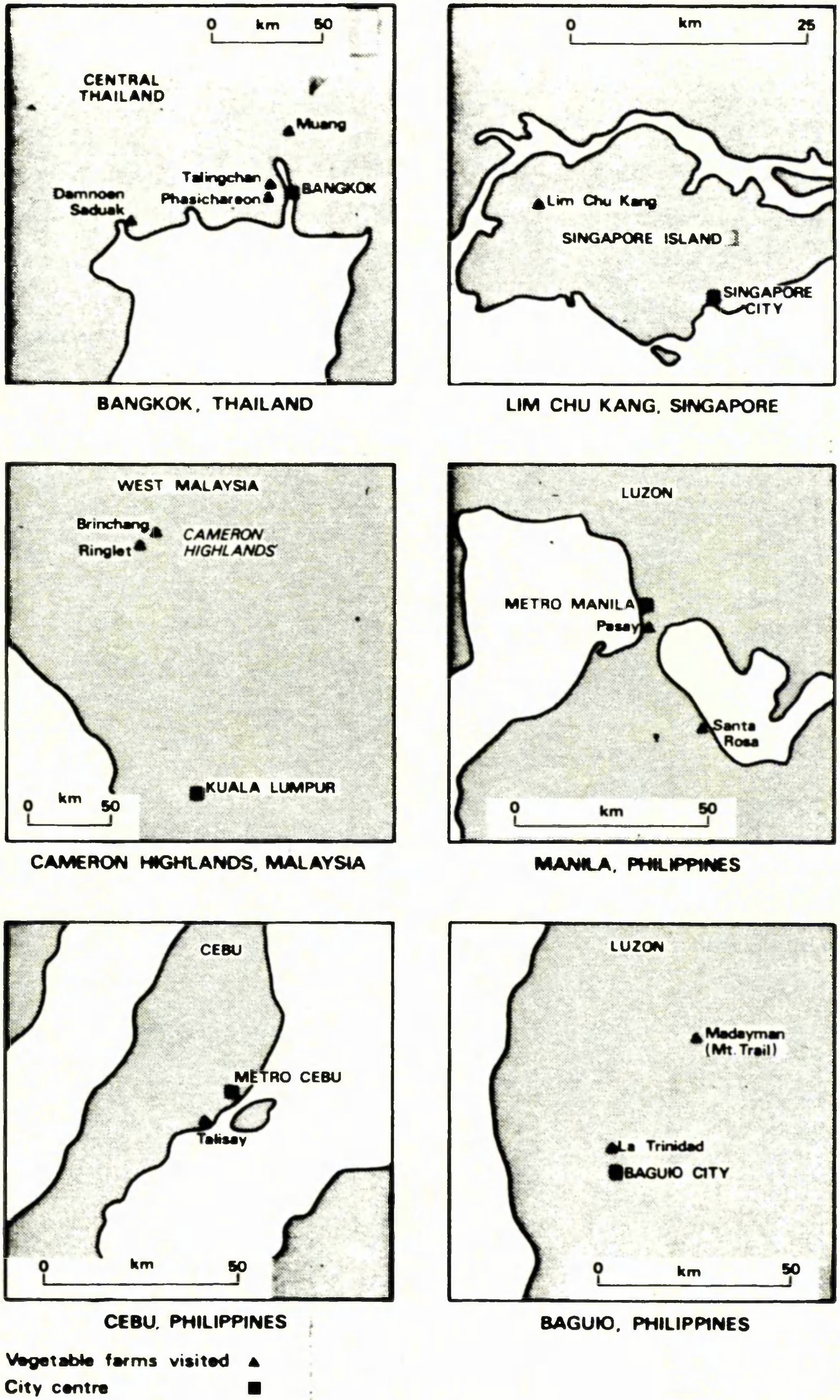


Figure 3.3 Locations of vegetable farms visited in the case study areas in Southeast Asia.

Table 3.4 Relief and natural drainage, case study areas in Southeast Asia.

Case study area	Altitude (1,2)	Landform (1,2)	Slope (2)	Natural drainage (2)
Bangkok	Lowland, near sea level	Delta	Flat	Very poor, prone to flooding
Singapore	Lowland, near sea level	Hills and valleys	Flat to moderately sloping	Good
Cameron Highlands	Highland, 1,400m	Hills and valleys	Steeply sloping	Good
Manila	Lowland, near sea level	Coastal and lake plains	Flat to gently sloping	Good
Cebu	Lowland, near sea level	Coastal plain	Flat	Good
Baguio	Highland, 1,500m	Hills and valleys	Gently sloping valley floors to steeply sloping hillsides	Good

Sources: 1. Fisher (1966: 23), Pendleton (1962: 35, 37, 57), Ooi (1976: 43, 44) and Wernstedt and Spencer (1967: 381, 468, 41).

2. Fieldwork, 1980/81.

Table 3.5 Climate and seasonality, case study areas in Southeast Asia.

Case study area	Climate (1)	Seasonality (1,2) (simplified)	Typhoons (2)	Latitude	Altitude
Bangkok	Tropical monsoon	Warm dry season, warm rainy season	Few	14 N	Lowland
Singapore	Equatorial	Warm and rainy all year round	None	1 N	Lowland
Cameron Highlands	Highland	Cool and rainy all year round	None	5 N	Highland
Manila	Tropical monsoon	Warm dry season, warm rainy season	Many	15 N	Lowland
Cebu	Tropical monsoon	Warm dry season, warm rainy season	Few	10 N	Lowland
Baguio	Highland	Cool dry season, cool rainy season	Many	16 N	Highland

Sources: 1. Fisher (1966: 40-41).

2. Pendleton (1962: 113-115), Ooi (1976: 29) and Wernstedt and Spencer (1967: 381, 468, 41).

Table 3.6 Mean monthly temperature, °C, case study areas in Southeast Asia.

Case Study Area	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Aver-age	Ra-nge	Lati-tude	Longi-tude	Alt-itude
Bang-kok (1)	25	26	29	31	30	29	29	28	28	28	27	25	28	6	14 N	101 E	Near sea level
Sing-apore (1)	26	26	27	27	27	27	27	27	27	27	26	26	27	1	1 N	104 E	Near sea level
Came-ron Highlands (1)	18	19	19	19	19	19	19	19	19	18	18	18	19	1	5 N	101 E	1370m
Man-ila (1)	26	26	27	28	29	28	28	28	27	27	26	25	27	4	15 N	121 E	Near sea level
Cebu (2)	26	26	27	28	28	28	27	28	27	27	27	27	27	2	10 N	124 E	Near sea level
Bag-uio (1)	18	19	20	21	21	20	19	19	19	19	19	18	19	3	16 N	121 E	1520m

Sources: 1. Fisher (1966: 422 ,587, 694).

2. Wernstedt and Spencer (1967: 608-611).

Note: Data from both sources metricated.

Table 3.7 Mean monthly rainfall, mm, case study areas in Southeast Asia.

Case Study Area	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total	Latitude	Longitude	Altitude
Bangkok (1)	10	18	66	30	160	150	157	208	305	241	76	13	1,434	14 N	101 E	Near sea level
Singapore (1)	216	155	165	175	183	170	173	216	180	208	254	264	2,359	1 N	104 E	Near sea level
Cameron Highlands (1)	152	132	163	312	267	127	122	198	213	328	307	246	2,567	5 N	101 E	1370m
Manila (1)	23	15	23	30	130	251	429	414	356	196	147	58	2,072	15 N	101 E	Near sea level
Cebu (2)	107	71	53	46	122	180	196	147	191	206	165	142	1,626	10 N	124 E	Near sea level
Baguio (1)	30	25	66	132	356	361	1,275	1,196	1,008	363	74	69	4,955	16 N	121 E	1520m

Sources: 1. Fisher (1966: 422, 587, 694).

2. Wernstedt and Spencer (1967: 608-611).

Note: Data from both sources metricated.

Table 3.8 Soils, case study areas in Southeast Asia.

Case study area	General description (1)	Soil texture on farms visited (2)
Bangkok	Alluvial, deep profile, seasonally saturated, dark heavy clays, low in organic matter and fertility	Heavy clays (cracking type)
Singapore		Variable, from sands, to sandy clay loams to heavy clays
Cameron Highlands	Poor, strongly leached, prone to erosion	Variable, from sands, to loams to clays
Manila	Alluvial, above average in quality and ease of cultivation	Sandy clay loam and heavy clay
Cebu	Calcareous, reasonably fertile	Sandy clay loam
Baguio	(Alluvial in valley floors) Skeletal on hillsides	Sandy clay loam and sandy loam

Sources: 1. Pendleton (1962: 66), Ooi (1976: 66,88), and Wernstedt and Spencer (1967: 381, 468, 77).

2. Fieldwork, 1980/81.

Table 3.9 Markets, case study areas in Southeast Asia.

Case study area	Main market (2)	Size of market (urban population) million people (1)	Proximity to market (2)	Transportation (2)	Marketing channel (2)
Bangkok	Greater Bangkok	3.5 (1972)	Near	High-speed boat, and truck	Dealers and cooperative
Singapore	Singapore (entire state)	2.1 (1970)	Near	Truck	Dealers
Cameron Highlands	Kuala Lumpur and Singapore	0.5 (1970) 2.1 (1970)	Far Far	Truck	Dealers
Manila	Metro Manila	3.2 (1970)	Near	Truck	Dealers and direct sale
Cebu	Metro Cebu	0.25 (1960)	Near	Truck	Dealers
Baguio	Metro Manila and Baguio City	3.2 (1970) 0.05 (1960)	Far Near	Truck	Dealers

Sources: 1. McGee (1979: 184), and Wernstedt and Spencer (1967: 171, 361).

2. Fieldwork, 1980/81.

Note: Regarding proximity to market, near is defined as less than 50 km and far as more than 200 km from main market.

Table 3.10 Farming structure, case study areas in Southeast Asia.

Case study area	Farm size, range, ha	Farm size, average, ha	Vegetable area, average, ha	Livestock numbers	Land tenure	Farm access
Bangkok	0.8-3.0	1.5	1.2	Very few (some poultry)	Mostly rented	Canal and road
Singapore	0.4-2.0	1.2	0.7	None on most farms (some poultry)	All rented	Road
Cameron Highlands	0.4 (one farm only)		No data	No data	No data	Road
Manila	0.1-3.0	1.4	1.4	None	Mostly rented	Road
Cebu	0.8-2.0	1.4	1.4	Few (some pigs and water buffalo)	Half rented	Road
Baguio	0.4-4.0	2.5	2.5	Few (some chickens, pigs, goats and cattle)	Half rented	Road

Source: Fieldwork, 1980/81.

Table 3.11 Farm labour supply, case study areas in Southeast Asia.

Case study area	Source of farm labour	Farmer's family size	Farmer's experience years (av.)	Race of farmer	Dialect group of Chinese farmers
Bangkok	Mainly farmer and his family, some hired labour	6	20	Chinese and Thai	Teochiu
Singapore	Farmer and his family only	6	21	All Chinese	Hokkien, Teochiu and Hakka
Cameron Highlands	No data	No data	No data	Chinese and Indian	Cantonese and others
Manila	Farm manager and hired labour, or just farmer	N.A.	17 (one farmer only)	Filipino	None
Cebu	Farmer and hired labour	7	30	Chinese and Filipino	Hokkien
Baguio	Farmer and his family, and hired labour	8	37	Chinese and Filipino	Cantonese

Source: Fieldwork, 1980/81.

Note: N.A. = Not applicable.

Table 3.12 Farm input supply, case study areas in Southeast Asia.

Case study area	Organic fertilizers, i.e., chicken and duck manure sources	Chemical fertilizers and pesticides, and farm machines, sources	Seed, bought or saved	Water sources
Bangkok	Nearby farms	Dealers	All bought	High water table and canals
Singapore	Nearby farms (one farm supplies own)	Dealers	Nearly all bought	Farm ponds
Cameron Highlands	Distant lowland farms	Dealers	No data	Streams
Manila	Nearby farms	Dealers	Most bought	Ground-water
Cebu	Nearby farms	Dealers	Most bought	Ground-water
Baguio	Distant lowland farms	Dealers	Nearly all bought	Ground-water and streams

Source: Fieldwork, 1980/81.

Note: Regarding seed, bought means bought from dealers, saved means saved from plants on farm.

CONCLUSION

In this chapter, information has been presented on the background to Chinese vegetable farming in Southeast Asia. Information has also been presented on the physical and human environments of the selected case study areas in Thailand, Singapore and Malaysia, and the Philippines. Information on the vegetable farming practices of these case study areas will be presented in Chapters 4,5 and 6, for Thailand, Singapore and Malaysia, and the Philippines, respectively.

CHAPTER 4

CHINESE VEGETABLE FARMING PRACTICES IN THAILAND: A CASE STUDY OF BANGKOK

INTRODUCTION

This chapter focuses on the vegetable farming practices used in Thailand, in particular the Bangkok area, the location of which is shown in Figure 3.3. The current practices used in the Bangkok area consist mainly of traditional Chinese and modern Western practices. Information on the physical and human environments of vegetable farming in Bangkok is given in Chapter 3.

Most of the information presented in this chapter was obtained during the writer's fieldwork in Bangkok in May 1981. In the course of the fieldwork 4 farmer interviews were conducted. Where available, comparable and confirmatory information from previous literature is also presented in this chapter, in the relevant sections.

CURRENT PRACTICES

Vegetable crops grown

The vegetable crops grown on the 4 farms visited are listed in Table 4.1. The crops most commonly grown, i.e., those grown on 2 or more of the farms, are Chinese white cabbage, Chinese kale, Swatow mustard, lettuce, celery and shallots.

Table 4.1 Vegetable crops grown, sample durations and planting methods, Bangkok.

Crops grown	Durations, days (1)	Planting method (1)	Durations, days (2)	Planting method (2)
Leafy vegetables				
Chinese white cabbage	40	DS/T	30-45	DS
Chinese kale		DS	30-60	DS
Swatow mustard	60	DS	35-60	DS
Lettuce		DS/T	35-45	DS
Celery	60-80	DS/T	45-60	DS
Water spinach	20	DS	15-30	DS
Coriander		DS	20-40	DS
Sweet basil				
Chinese chives	(2-4 years)	T	(2 years)	T
Fruit vegetables				
Hot pepper			60-90	T
Sweet pepper			90-120	DS
Root vegetables				
Shallot			25-45	T
Chinese radish	50		30-40	DS
Sweet potato				
Taro				

Sources: 1. Fieldwork, 1981.
2. Sritunya (1975: 37-69).

Notes: (a) All time periods are given in days, rounded to the nearest 5 days.

(b) DS = Directly sown. T = Transplanted.

(c) Sritunya (1975) reported that celery cabbage, beans, sweet corn cucumber, broccoli, cauliflower and tomato are also grown in the Phasichareon and Talingchan districts near Bangkok.

(d) "Pak choi" referred to by Sritunya (1975: 48) is taken to be Chinese white cabbage (Brassica chinensis), and not flowering white cabbage (B. chinensis var. parachinensis) as indicated in his study.

Intensity of cropping

On the 4 farms visited, 3-6 crops per year are grown on the same beds with an average of 4.4 crops per year. Sritunya (1975: 19) reported averages of 3.5 and 5.2 crops per year grown at Talingchan and Phasichareon, with ranges of 1-7 and 4-6.2 respectively. The average figure for Talingchan is low because Chinese chives, grown throughout the year and harvested several times, is only counted as 1 crop. Boonma and Welsch (1973: 8) reported that an average of 4 crops per year are grown at Talingchan. An approximate average for both areas, based on Sritunya's data, is 4.4 crops/year, a figure which is the same as the present writer's figure.

Crop durations

Information on crop durations was obtained from 2 of the farms visited and is given in Table 4.1. Comparable information reported by Sritunya (1975: 37-69) is also given in Table 4.1.

Planting methods

Most leafy vegetables are directly sown, i.e., seed is broadcast on to the field beds and thinned later, as shown in Table 4.1. However, sometimes Chinese white cabbage, lettuce and celery are sown in nursery beds and transplanted later into the field beds. Chinese chives are also transplanted.

Interplanting

Interplanting is occasionally practised, e.g., Chinese kale is interplanted with lettuce, shallots with lettuce, and celery with Chinese white cabbage.

Staggering of planting dates

On the same farms on the same day different field beds were observed with the same vegetable crops at different stages of growth, from land preparation through to harvest. Hence, planting dates of the same crops on the different beds are staggered.

Diversified cropping

A range of different leafy, fruit and root vegetable crops is also grown at the same time on different field beds of the same farms; one field bed is usually planted with one crop, the next field bed with another crop. Hence, cropping is diversified.

Rotations

Crop rotation is practised, but no regular pattern is followed.

Field and bed layouts

The fields of all of the 4 farms visited are levelled and bunded. The field bunds are in fact large earth dykes, varying in height from 1-3 m. These dykes often form the banks of canals, which are large enough to be navigable by narrow motorized canal boats. The dykes and canals together make possible water control in the farming area around Bangkok which is low-lying and prone to flooding during the rainy season. The canals facilitate the drainage of excess water from the fields. They also provide irrigation water during dry periods. It was reported that the fields were previously used for wetland rice production before being turned into vegetable fields.

High raised beds with large flooded furrows or ditches between them are constructed in all of the vegetable fields. As in Canton, the main function of the ditches is to ensure adequate drainage of the vegetable beds in low-lying areas prone to flooding. However, the high beds and ditches in Bangkok are much larger than those found in Canton. When measured from centre to centre, i.e., including half of the ditch around each bed, typical bed dimensions are as follows: width, 5-7 m; height, 0.9-1.0 m; and length, variable, 30-80 m. The beds are markedly convex in shape on their top surfaces, which not only further helps drainage but also provides a greater surface area of growing space on each bed. The width of the ditches between the beds varies from 1-2 m, the wider ditches being associated with the wider beds.

Around the edge of each bed a narrow, flat footpath is constructed and this is left unplanted. As in Canton, the ditches also provide small boat access to the beds; the small boats being used to carry farm inputs to and harvested produce from the beds. In Bangkok though, small boats additionally carry irrigation water pumps and sprayers.

Cultivations

Land preparation for vegetable crops is carried out by hand with hoes, including forked and bladed types. No animal-drawn or mechanized equipment is used. Hoeing is carried out between each crop grown, every 2-3 months. The ditches between the beds are dredged and the mud returned to the tops of the beds at the same time.

Mulching

Large amounts of rice straw are used to mulch directly sown field beds. Rice straw is also used to mulch established Chinese chive crops. Sritunya (1975: 37-69) reported that 2.0-3.3 t/ha/crop of rice straw is used for the mulching of different vegetable crops.

Overhead protection of seed beds

On one farm, palm fronds supported on a bamboo framework were set up to provide shade for celery seedlings.

Trellising

No trellising was seen on the 4 farms visited, as trellis crops are not grown on these farms.

Clay pots for blanching Chinese chives

The use of clay pots was reported by Sritunya (1975: 66), although it was not seen by this writer.

Organic fertilizers: materials and preparation

Duck manure is the main type of organic fertilizer used on the 4 farms visited. Chicken manure is also used on 2 of the farms. Nightsoil is not used. Nuttonson (1963: 99) reported that the use of nightsoil for fertilizing vegetables is prohibited in Thailand by law. He also reported that vegetable growers in and around Bangkok use duck manure because the source of supply is near and it can be obtained in large quantities. Sritunya (1975: 43-51) observed that the duck manure is well rotted before being applied. He also reported (p. 28) that crop residues are ploughed back into the soil.

Organic fertilizers: application rates

The application rates, reported by the 4 farmers, of dry duck and chicken manure, expressed in metric units, range from 2.7-16.0 t/ha/crop, with an average of 7.1 t/ha/crop. Based on the numbers of crops grown per year on the different farms, the annual application rates range from 9-96 t/ha/year, with an average of 36 t/ha/year. Sritunya (1975: 37-69) reported that farmers in Phasichareon and Talingchan apply 2.7-6.7 t/ha/crop of duck manure to typical vegetable crops. However, these application rates do vary between the different crops.

Organic fertilizer: application timing and placement

The timing of duck and chicken manure application was reported to vary from 1 time per 2 crops to 2 times per crop. These fertilizers are broadcast on to the field beds either after sowing as a basal dressing, or during crop growth as a top dressing, or both. However, Nuttonson (1963: 99) reported that duck manure was broadcast onto prepared beds prior to sowing.

Chemical fertilizers

Chemical fertilizers are used on all 4 of the farms visited. Several different types are applied, including, ammonium sulphate (21% N), urea (46% N) and compound fertilizers, e.g., $N : P_2O_5 : K_2O$ - 13:13:21 and 15:15:15.

The rates of application and the combinations in which the different types are applied vary between the different farms and between the different crops. However, the application rates of the different fertilizers, combined together for different vegetable crops on different farms, range from 0.90-2.25 t/ha/crop, with an average of 1.35 t/ha/crop. Annual application rates, based on the numbers of crops grown per year on the different farms, range from 3.2-9.0 t/ha/year, with an average of 5.3 t/ha/year. Sritunya (1975: 37-69) reported typical application rates of about 1.7 t/ha/crop, made up of about 1.0 t/ha/crop of ammonium sulphate and 0.7 t/ha/crop of complete fertilizer, e.g., 15:15:15. An estimate of the total nutrients applied is given in Table 4.2.

The 4 farmers interviewed make up to 3 applications per crop, the fertilizer being either broadcast or watered on the beds.

Lime is applied on one farm 3 times per year, the lime being mixed into the soil by hoe. Sritunya (1975: 43-63) reported a typical application rate of 1.3 t/ha/crop of lime on a range of vegetable crops.

Irrigation

Adequate water for crop irrigation in dry weather is supplied basically by the high water table. It is also supplied by the flow of water in the canals between the fields. These small canals are linked up with the Chao Phraya river by means of main canals. On 3 of the 4 farms visited canal water is allowed to flow by gravity through canal gates into the field ditches, but on the other farm a diesel-powered, belt-drive, dragon bone pump is necessary to lift water from the canal into the field ditch network.

Table 4.2 Fertilizer nutrients applied to vegetable crops, Bangkok.

Fertilizer	Amount applied, t/ha/crop	Nutrient content, N, %	Nutrient content, P_2O_5, %	Nutrient content, K_2O, %	Nutrients applied, total N, kg/ha/crop	Nutrients applied, total P_2O_5, kg/ha/crop	Nutrients applied, total K_2O, kg/ha/crop
Duck manure	7.1	0.75	1.5	0.075	53	107	5
Ammonium sulphate	0.84	21	-	-	176	-	-
Complete, 15:15:15	0.56	15	15	15	84	84	84
		Total nutrients applied per crop			313	191	89
		Total nutrients applied per year (@ 4.4 crops/year)			1,377	840	392

Sources: 1. Fieldwork, 1981.

2. Nuttonson (1963: 99).

Notes: (a) Total organic fertilizer applied is taken as 7.1 t/ha/crop of duck manure.

(b) Total chemical fertilizer applied is taken as 1.4 t/ha/crop, 60% ammonium sulphate and 40% complete 15:15:15.

(c) Nutrient content of duck manure is taken from Nuttonson (1963: 99), who gave the chemical analysis of duck manure in the Bangkok area as about 0.5-1.0% N, 1-2% P_2O_5 and 0.05-0.1% K_2O.

(d) Nutrient content of chemical fertilizers is self-evident from the ratios, which represent percentages of nutrients.

(e) Total nutrients applied per year assumes that 4.4 crops are grown per year.

Water in the ditches is maintained at an optimal level for crops growing on the field beds, so that the crop roots can obtain water from the lower levels of the beds. When necessary, water is scooped up by long-handled scoops from the ditches and splashed over the beds by hand. On some farms water is sprayed over the beds by petrol-powered pumps mounted on small boats, which are towed along the ditches by hand. Each of these floating pumps is fitted with two sprinklers, so that water is sprayed over half of each bed either side of the ditch, along which the floating pump is towed.

Regarding irrigation scheduling, Boonma and Welsch (1973: 8) reported that growing crops are watered 4 times per day, either manually or by floating pump, at Talingchan. Sritunya (1975: 37-69) reported that growing crops are watered 1-3 times per day, depending on the type and age of the crop.

Drainage

During rainy weather, the ditches function as open drains removing excess water from the field beds. On 3 of the 4 farms visited water is pumped out of the field ditches into the canals by diesel-powered dragon bone pumps. On the other farm excess water flows out by gravity to the canal, through a canal gate.

Of great importance during the rainy season, when widespread inundation of farm land in the Bangkok area regularly occurs, is the function of the dykes to protect the vegetable fields from severe flooding, with water which would otherwise come in from the surrounding inundated rice lands. Hence, with the ditch, dyke and canal system, assisted where necessary by drainage pumps, vegetables may be grown continuously throughout the year on land naturally prone to seasonal inundation.

Weeds and weed control

The field beds of the 4 farms visited were all clean weeded, as were the ditches between them. Weeding is carried out by hand and herbicides are not used. Mulching of vegetable beds with rice straw helps control weeds.

Pests and pest control

All 4 of the farmers visited reported that insect pests were a major problem. A variety of insecticides are used including Sumicidin (fenvalerate) and Dicot(?). Insecticide spraying frequencies range from one spraying every 3-7 days on each crop. But even at this frequency of application, farmers report that insecticide sprays were not very effective in controlling insect pests.

Information on the particular insect pests involved was not collected by the writer. However, Sritunya (1975: 44-68) reported the following insect pests as causing problems: cabbage butterfly, tobacco caterpillar, diamond back moth and cutworm on Chinese kale and cabbage (p.45 and 60) aphids on cucumber (p.56); and onion thrips on shallots/green onions (p.68). Small snails are also a problem on celery cabbage (p.44). He reported that a variety of insecticides were sprayed, including Tamaron (metamidophos), at a frequency of one spraying every 10-15 days.

Diseases and disease control

Little information was obtained on this. One farmer reported that he did apply fungicides, usually mixed together with insecticides. Sritunya (1975: 60) reported that "damping off" was a disease affecting cabbage in the seedling stage. He also reported that fungicides, e.g., Daconil (chlorothalonil), were sprayed onto several crops, often mixed with insecticides (p. 44-68).

Harvesting and packing

Vegetables are harvested by hand. Sometimes, harvested vegetables are transported in small boats, towed along the ditches, from the field beds to the edge of the field where they are packed. Prior to packing in bamboo baskets some vegetables are washed, and old and damaged leaves are removed.

CROP YIELDS

Yield per crop

Yield data reported by the 4 farmers visited are given in Table 4.3. Comparable information reported by Sritunya (1975: 37-69) is also given in Table 4.3. No information was obtained concerning the yield variation between interplanted crops and crops grown as pure stands, nor between wet and dry season crops.

Annual yield

No information was obtained on the total annual yield of crops on a per hectare basis.

Table 4.3 Vegetable crop yields, Bangkok.

Crop	No. of samples (1)	Yield per crop (1), range, t/ha/crop	Yield per crop (1), average, t/ha/crop	Yield per crop (2), range, t/ha/crop	Yield per crop (2), average, t/ha/crop
Chinese white cabbage	4	12.5-47.0	25.2	11.7-13.3	12.5
Chinese kale	3	17.9-26.9	21.6	15.0-16.7	15.9
Swatow mustard	3	17.9-37.5	26.6	23.3-26.7	25.0
Celery	1	7.5-10.0	8.8	8.3-10.0	9.2
Chinese chives (per cut)	1	5.0-10.0	7.5	3.3- 6.7	5.0

Source: 1. Fieldwork, 1981.

2. Sritunya (1975: 37-69).

Note: (a) Yield per crop data reported by Sritunya (1975) are included in this table for comparison. Other yield data reported by Sritunya (1975: 37-69) include lettuce 13.3-16.7 (av. 15.0) t/ha/crop; and water spinach (dry bed), 6.7-8.3 (av. 7.5) t/ha/crop.

LABOUR USE

Labour used per hectare

The estimated amount of labour used on the 4 farms visited, based on full-time labour equivalents (see Appendix C), ranges from 1.0-4.5 persons/ha, with an average of 3.0 persons/ha.

Farm labour is mainly provided by the farm family. Only on 2 of the 4 farms is farm labour hired, and then only for weeding and harvesting work. On these 2 farms, hired labour is assumed to amount to 1 full-time labour equivalent per farm.

Labour used per hectare per crop

Based on the numbers of crops grown per year on the 4 farms visited, the labour used ranges from 0.3-1.0 persons/ha/crop, with an average of 0.7 persons/ha/crop.

CONCLUSION

In this chapter, data have been presented on the current practices, both traditional Chinese and modern Western, the crop yields and the labour use of vegetable farming in Bangkok. Analyses of these data will be presented in Chapters 7 and 8, on a comparative basis with data from the other case study areas.

Field and canal layouts on low-lying, wet land

Raised beds, ditches, dyke and canal

Raised beds and ditches (water spinach)

Vegetable farming in Bangkok

Plate 4.1

Rice straw mulch

Overhead protection of seed beds with palm fronds (celery)

Interplanting (Chinese kale with lettuce)

Vegetable farming in Bangkok

Plate 4.2

Duck manure store

Hand watering with long-handled scoop

Sprinkler irrigation with pump boat

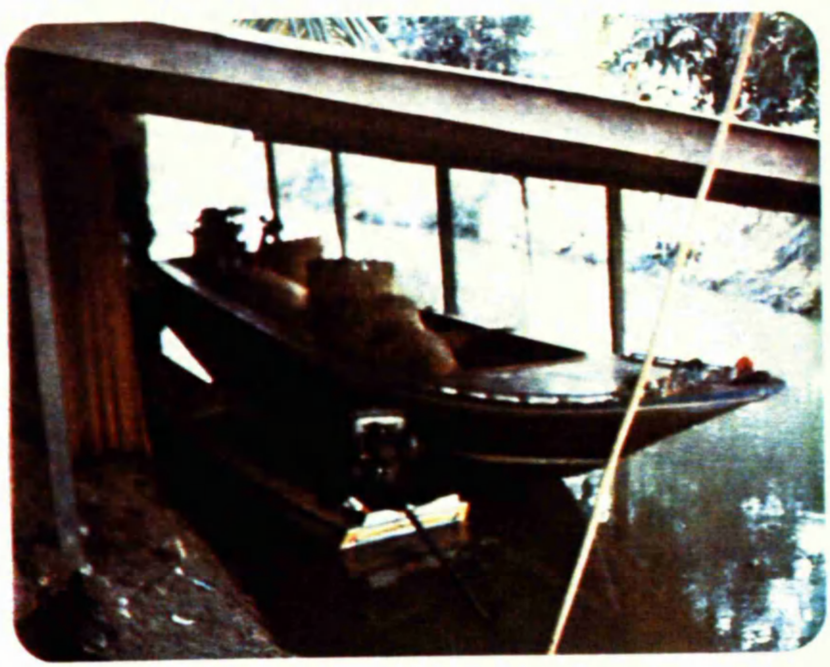
Vegetable farming in Bangkok

Plate 4.3

Dragon bone pump for field drainage

Packing harvested vegetables into bamboo baskets

Farmer's boats for transporting vegetables to market



Vegetable farming in Bangkok

Plate 4.4

CHAPTER 5

CHINESE VEGETABLE FARMING PRACTICES IN SINGAPORE AND MALAYSIA: CASE STUDIES OF LIM CHU KANG IN SINGAPORE AND THE CAMERON HIGHLANDS IN MALAYSIA

INTRODUCTION

This chapter focuses on the vegetable farming practices used in Singapore, in particular in the Lim Chu Kang area, and in Malaysia, in particular in the Cameron Highlands area, the locations of which are shown in Figure 3.3. The current practices used in these areas consist mainly of traditional Chinese and modern Western practices. Information on the physical and human environments of vegetable farming in these areas is given in Chapter 3.

Most of the information presented in this chapter was obtained during the writer's fieldwork in Lim Chu Kang in May 1981 and in the Cameron Highlands in August 1980. In the course of the Lim Chu Kang fieldwork, 7 farmer interviews were conducted. In the course of the Cameron Highlands fieldwork, informal discussions with 4 farmers were held. However, no quantitative data were collected for this second area.

Where available, comparable and confirmatory information from previous literature is also included in this chapter, in the relevant sections. In the case study of Lim Chu Kang though much of this information pertains to other former vegetable farming areas in Singapore, many of which are now built-up areas. However, it is included because it gives further insight into the use of traditional Chinese vegetable farming practices in Singapore. Hence, the case study of Lim Chu Kang forms part of a wider case study of Singapore in general.

(A) A CASE STUDY OF LIM CHU KANG

CURRENT PRACTICES

Vegetable crops grown

The vegetable crops grown on the 7 farms visited in Lim Chu Kang are listed in Table 5.1. The crops most commonly grown, i.e., those grown on 6 or more of the farms, are flowering white cabbage, Chinese kale, Chinese spinach, lettuce and water spinach. Other commonly grown crops, i.e., those grown on 3 or more of the farms, are hot peppers and shallots.

Intensity of cropping

On the 7 farms visited, 5-10 crops per year are grown on the same beds, with an average of 7.4 crops per year. Suijkerbuijk (1982: 21) in a study of 29 farms farms in Lim Chu Kang, including the 7 farms visited by the present writer, estimated that most of the farmers grew about 7 or 8 crops per year, predominantly of leafy vegetables.

Crop durations

Information on crop durations was obtained from 3 of the farms visited and is given in Table 5.1, together with comparable information from previous literature. It can be seen from the table that most of the commonly grown leafy vegetable crops are of short duration.

Table 5.1 Vegetable crops grown, sample durations and planting methods, Singapore.

Crops grown	Duration, days 1	Planting method 1	Duration, days 2	Planting method 2	Duration, days 3	Planting method 3
Leafy vegetables						
Flowering white cabbage	30-35	DS	35	DS	35-40	DS
Chinese white cabbage						
Chinese kale	50	DS	45	DS	50-55	DS
Chinese spinach	20-30	DS	25	DS	25-30	DS
Lettuce		DS	40	DS/T	45-55	DS
Water spinach	25-30	DS	30	DS	25-30	DS
Chinese box thorn	(Perennial)					
Chinese chives	(Semi-perennial)					
(Herbs)						
Fruit vegetables						
Yard-long beans						
Cucumber					30-35	DS
Hot peppers	60+				80-90	T
Eggplant	(1-2 years)	T			170-180	T
Okra					65-75	DS
Root vegetables						
Shallots/spring onions					30	DS

Sources: 1. Fieldwork, 1981.
2. Suijkerbuijk (1982: 33-35, 66).
3. Chua and Teoh (1975: 16).

Notes: (a) All time periods are given in days, rounded to the nearest 5 days.
(b) DS = Directly sown. T = Transplanted.
(c) Crops other than those listed are, or were, commonly grown in Singapore, according to previous writers. These include watercress (Blaut, 1953: 40 and Fan 1969: 90), celery, coriander and bitter cucumber (Ng et al, 1966: 178), and French bean (Fan, 1969: 77).

Further information on the duration of transplanted flowering white cabbage has been provided by previous writers. Nursery periods and field bed periods, respectively, have been reported as follows: 20 and 21 days (Blaut, 1953: 40-41), 30 and 17 days (Tan, 1963: 174-175), and 25 and 17 days (Ng et al, 1966: 180-182). These figures give crop durations ranging from 41-47 days, of which only 17-21 days take place in the field beds. It can be seen from these figures that although flowering white cabbage has a longer duration when transplanted than when directly sown, the transplanted crop requires less time in the field beds. The same effect also applies to other crops as well.

Planting methods

Nearly all of the leafy vegetable crops grown in Lim Chu Kang are directly sown, i.e., seed is broadcast on to the field beds, as can be seen from Table 5.1. Humid or wet weather is preferred for sowing as it enhances seed germination. Thinning of seedlings, except those of Chinese spinach and water spinach, takes place some days after seedling emergence and is usually combined with hand weeding. The thinnings are thrown away. However, occasionally lettuce and very occasionally flowering white cabbage and Chinese kale are sown in nursery beds and later transplanted into field beds. Eggplant is also transplanted by the one farmer interviewed who grows it. It may be that transplanting is not widely practised in Lim Chu Kang because of a shortage of farm labour, i.e., a relatively high cost of hired labour.

Previous literature indicates that transplanting of vegetable crops was more commonly practised in the past. Blaut (1953: 41), Tan (1963: 173-175) and Ng et al (1966: 177-180) all reported that flowering white cabbage, which was taken by these writers as a representative crop, was sown in nursery beds and transplanted. They did not report any instances of direct sowing of flowering white cabbage. Ng et al (1966: 177) also reported that most of the vegetables, the bulk of which were leafy types, were sown in nursery beds and transplanted.

Interplanting

Interplanting is very rarely practised at Lim Chu Kang. Only one instance was reported, viz., eggplant interplanted with Chinese spinach, but this was not seen by the writer. Surprisingly, it appears that interplanting was not commonly practised in the past. At least, it was not reported on by previous writers, e.g., Blaut (1953), Tan (1963), Ng et al (1966) and Fan (1969).

Staggering of planting dates

Staggering the planting dates of crops is practised by all the farmers interviewed. On the same farm on the same day, the same crop may be seen at different growth stages on different field beds. For example, on one farm visited there were 4-5 separate sowing dates for a Chinese spinach crop. At each sowing date 6-8 beds had been sown. The sowing dates had been separated by 3-4 day intervals. On another farm, the intervals between separate sowing dates of flowering white cabbage varied between 3-8 days.

Staggering of planting dates was reported to provide several advantages. Firstly, it evens out farm work and removes peaks of labour demand. Secondly, it spreads the harvest time of any one crop over many days and this facilitates daily sales of vegetables, so providing the farmer with a regular daily income. Thirdly, it provides an insurance against crop damage or failure, especially damage to seedlings caused by heavy rainstorms, as only a part of the crop is in the easily damaged seedling stage at any one time.

Diversified cropping

A range of different, mainly leafy, vegetable crops was seen growing at the same time in different fields of the same farms.

Rotations

Crop rotation, mainly of leafy vegetables, is practised by all of the farmers, but it appears that the crops are not rotated according to any particular order. The farmers reported that they vary the order of rotation according to market prices. The farmers very rarely plant the same vegetable crops in immediate succession; the only exception being flowering white cabbage, which is sometimes monocropped by one of the farmers interviewed. Generally, the farmers are well aware of the benefits of crop rotation in maintaining soil fertility and controlling crop pests and diseases.

Field and bed layouts

In Lim Chu Kang, the vegetable fields, which are laid out on gently to moderately sloping land, are unterraced, unlevelled and unbunded. This land has not previously been used for growing wetland rice and, therefore, paddy fields have never been constructed on it in the past.

Raised beds are constructed with footpaths between each bed to provide access to crop plants and adequate drainage. Bed dimensions vary from farm to farm, particularly in length. When measured from centre to centre, i.e., including half of the footpath around each bed, the typical dimensions are as follows: width 1.6 m, height 0.10-0.15m and length 15-22 m, approximately. Suijkerbuijk (1982: 64), in his study of 29 farms in Lim Chu Kang, considered average bed dimensions to be: width 1.6m and length 15m, measured from centre to centre. The beds are usually aligned along the contours of the sloping land. The length of the beds is determined by the shape of the field and slope of the land. The width of the beds is determined by the length of arm's reach of the farmer, viz., to reach the centre of the bed from the footpath.

Similar field and bed layouts were reported by previous writers, even on flatter, lower lying land in some cases. Bed dimensions, i.e., widths (measured as widths of top surfaces only, omitting footpaths between beds), heights and lengths, were reported as follows:

(i) 0.9 m x 0.15 - 0.20 m x 12 m (Blaut, 1953: 39);

(ii) 1.2 m x 0.30 m x 5 - 12 m (Tan, 1963: 173-174);

(iii) 0.9 x 0.15 - 0.20 m x 2 - 20 m (Ng et al 1966: 176).

Cultivations

Implements used by farmers in Lim Chu Kang include large tractors and ploughs, small mechanical cultivators (rotary cultivators), and hoes and rakes. Large tractors and ploughs are hired for use once or twice a year on most farms in order, according to the farmers, to raise up fertile soil by relatively deep ploughing. Small mechanical cultivators, 5-7 HP, are owned by all the farmers visited. They are used for raising up the beds and also, in some cases, to incorporate applied chicken manure into the soil of the beds. Hoes ("changkol") and rakes are used by all farmers for shaping and levelling the beds and for making the footpaths between the beds. Previous writers, e.g., Blaut (1953: 41) and Ng et al (1966: 178-180), reported that, at the time of their observations, hoes were used for land preparation; no tractors or mechanical cultivators were used.

After harvest of one crop there is a short fallow period of one or two weeks, depending on the farmer's work load. Fields are subsequently prepared on a part-by-part basis, as opposed to the whole field being prepared at the same time, e.g., 6 beds are prepared on one day and another 6 beds several days later. This spreads work and maintains continuity of work. The first job is to clear weeds and crop residues with hoes, in some instances after an application of herbicide. Tractor ploughing sometimes follows and, afterwards, the beds are raised up again. Chicken manure is spread in most cases and the beds are hoed or rotavated to mix the chicken manure into the soil. After shaping and levelling of the beds with hoes and rakes, they are seeded by broadcasting, usually on cloudy, humid or wet days. Sometimes, after seeding, the beds are mulched with a layer of woodshavings.

Mulching

Some of the farmers interviewed use woodshavings as a mulch to cover sown beds, in order to prevent soil erosion and soil capping, to stop seeds being washed away by heavy rain and to prevent weed growth. No other materials are used for mulching. However, Ng et al (1966: 180-181) reported that nursery seed beds were protected from hot sun or torrential showers by a layer of palm fronds ("atap") placed over them for short periods while seeds were germinating.

Trellising

Only one of the farmers visited was seen using trellises. These were trellises of sticks, not bamboo, for a cucumber crop. Most of the farmers though grow leafy vegetables as opposed to beans and gourds. Hence, trellises are not required.

Organic fertilizers: materials and preparation

All 7 farmers interviewed use chicken manure as their only organic fertilizer. Nightsoil is not used at all. The chicken manure is usually bought from nearby livestock farmers, except in one case where the farmer's own chickens provided the manure for the vegetable fields. The chicken manure, which is obtained in dry form, is kept in stores or shelters on the farms prior to application either under corrugated iron roofs or just in corrugated iron covered heaps. Information on the length of time the manure was kept before application was not obtained.

Blaut (1953: 41)) and Tan (1963: 173-175) reported that, at the times of their observations, prawn dust and burnt earth were the organic fertilizers used. Prawn dust, the main fertilizer, was a by-product of the Sumatran shrimp industry and had been used to sustain leafy vegetable production in Singapore for over 30 years on the same land (Tan, 1963: 177). On one closely studied farm, prawn dust was applied at a rate of 99 t/ha/year, viz., 44 short tons per acre during 1952, either in dry form, or in liquid, decomposed form (Blaut, 1953: 45). Burnt earth was made from baking soil and weeds together, in a mixture that was kept permanently smouldering. When baked sufficiently, it was returned to the beds prior to planting (Blaut, 1953: 41). Burnt earth, when applied to the beds, gave the surface soil a fine tilth (Tan, 1963: 174).

Apart from reporting the use of prawn dust, Ng et al (1966: 178-182) also reported that diluted pig manure and nightsoil, and sometimes chicken manure, were used as fertilizers. Fan (1969: 79) reported that chicken manure was the most commonly used organic fertilizer at Lim Chu Kang in the late 1960's, although soya bean cake (soya beans after oil extraction) and prawn dust were also used but to a lesser extent; prawn dust was commonly used in other parts of Singapore (p. 96).

Organic fertilizers: application rates

In the time available, it was not possible for the writer to scientifically measure the application rates of the chicken manure on the farms visited. However, the farmers were able to provide information on the number of wheelbarrows of chicken manure applied to each bed for each crop and a very approximate estimation of application rates has been prepared from these data. The assumption has been made that one wheelbarrow full of dry chicken manure weighs 20 kg. On this basis it has been estimated that the farmers apply 3.3-8.3 t/ha/crop of dry chicken manure, with an average of 6.3 t/ha/crop. Based on the numbers of crops grown per year on the different farms, the annual application rates range from 25-75 t/ha/year, with an average of 46 t/ha/year. These figures do not distinguish between the different vegetable crops grown. However, it is known that the actual application rate is affected by the type of crop, the condition of the soil and the farmer's own preference. Suijkerbuijk (1982: 58) reported a similar average application rate, equivalent to 6.6 t/ha/crop, viz., an average rate of 133 x 20kg wheelbarrows full per acre for 5 different leafy vegetable crops, in his study of 29 farms in Lim Chu Kang.

Organic fertilizers: application timing and placement

Chicken manure is applied usually one or two times per crop, the first basal application being at land preparation or just after sowing and the later application during crop growth. Basal applications are usually mixed into the soil, but subsequent applications are top dressings and are not mixed into the soil. It is interesting to note in this context that the Singapore Primary Production Department (1974) recommended that organic manure (chicken manure or prawn dust) should be applied at a rate of 15 t/ha/crop before sowing or transplanting, and covered with soil to help reduce fly-breeding.

Chemical fertilizers

All 7 farmers interviewed use ammonium sulphate nitrate (26%N) as their only chemical fertilizer. Hence, they only apply nitrogen, and not phosphorus and potassium. This high nitrogen chemical fertilizer is used as a supplementary fertilizer to chicken manure.

Information on application rates was obtained from 3 of the 7 farmers. Based on the number of 50 kg bags applied per bed, it is estimated that the farmers apply 0.42 - 0.83 t/ha/crop, with an average of 0.61 t/ha/crop. Based on the numbers of crops grown per year on the different farms, the annual application rates range from 3.8 - 6.2 t/ha/year, with an average of 4.7 t/ha/year. As with chicken manure, the application rate varies with crop type and farmer's preference. An estimate of the total nutrients applied is given in Table 5.2. Most of the farmers make one or two applications per crop as top dressings. Suijkerbuijk (1982: 58) reported a lower average application rate, equivalent to 0.4 t/ha/crop, viz., an average rate of 158 kg/acre for 5 different leafy vegetable crops, in his study of 29 farms in Lim Chu Kang.

Table 5.2 Fertilizer nutrients applied to vegetable crops, Singapore.

Fertilizer	Amount applied t/ha/crop	Nutrient content, N, %	P, %	K, %	Nutrients applied, N, kg/ha/crop	P, kg/ha/crop	K, kg/ha/crop
Chicken manure	6.3	1.87	3.31	1.32	118	209	83
Ammonium sulphate nitrate	0.6	26	-	-	156	-	-
		Total nutrients applied per crop			274	209	83
		Total nutrients applied per year (@7.4 crops/year)			2,028	1,547	614

Sources: 1. Fieldwork, 1981.

2. Koay and Chua (1978: 80).

Notes: (a) Total organic fertilizer applied is taken as 6.3 t/ha/crop of chicken manure.

(b) Total chemical fertilizer applied is taken as 0.6 t/ha/crop of ammonium sulphate nitrate (26%N).

(c) Nutrient content of chicken manure is taken from Koay and Chua (1978) and is for air-dried, well-decomposed chicken manure.

(d) Total nutrients applied per year assumes that 7.4 crops are grown per year.

It is interesting to note in this context that the Singapore Primary Production Department (1974) recommended that chemical fertilizer, e.g., Nitrophoska blue, should be applied at a rate of 0.4 t/ha/crop, in two top dressings.

Previous writers, viz., Blaut (1953), Tan (1963) and Ng et al (1966), did not report the use of chemical fertilizers. Only Fan (1969: 79) reported their use. Hence, it appears that the use of chemical fertilizers is a fairly recently adopted practice.

Liming is rarely carried out, and of the 7 farmers interviewed only one applied lime to his land. In this case, the reported application rate was 0.06 t/ha/year, applied once per year. In contrast, previous writers reported that liming was commonly carried out during bed preparation, especially of nursery beds (Blaut, 1953: 41; Tan, 1963: 173-174; Ng et al, 1966: 178; and Fan, 1969: 96).

Irrigation

All the farms visited have small ponds or sumps, fed by drainage water, small streams or underground water, which supply the farms with irrigation water, and have pump and pipeline systems for distributing irrigation water to the field beds. The pumps are usually diesel-powered, 5.0-7.5 H.P., but on one farm the pump was electric. Some farms have G.I. pipelines, whereas others have P.V.C. pipelines.

Nearly all the farmers use flexible plastic hoses with spray nozzles (or roses) to apply water to the vegetable beds. However, on one farm, a new sprinkler irrigation system had just been installed, with a P.V.C. pipeline network and rotary sprinkler heads. On the farms visited, irrigation water is applied once or twice per day, depending on the weather.

Buckets are no longer used for irrigation on any of the 7 farms visited, although in the past buckets were the sole means of watering the vegetable beds according to previous writers. Blaut (1953: 41-42) and Tan (1963: 175) reported that in the traditional method of pond and bucket (or sump and bucket) watering, the farmer carries two open-topped wooden or metal buckets suspended from either end of a stick, known locally as a "kanda" stick, which is supported on his shoulders. The buckets, each hold about 18 - 27 litres of water. They are fitted with spouts, each having a valve flap instead of a rose. The valve flap breaks the pressure of water in the spout and this allows the water to flow out in a broad sheet on to the crop plants without damaging them. Carrying his pair of buckets, the farmer steps down into a pond or sump, leans forward to fill the buckets, then carries the water back to the beds, and waters the crops from both buckets simultaneously. Watering is undertaken regularly, up to 4 times per day depending on the weather, but usually around 2 or 3 times per day. Ng et al (1966: 182) reported that newly transplanted seedlings were watered 3 or 4 times per day if the weather was hot and 2 times per day when there was less sunshine. On nearing maturity the plants were watered 1 time per day, but only when conditions were sunny or dry.

Drainage

On all 7 farms the raised bed and footpath layout provides effective drainage during heavy rainstorms, the excess water running off along the footpaths between the beds. The sloping land at Lim Chu Kang also helps field drainage, and runoff flows quickly down to the stream courses or farm sumps.

Weeds and weed control

On all the farms visited, the fields and crop beds appear clean weeded. Most crops are hand weeded when the seedlings are thinned, i.e., once per crop. In addition, 6 of the 7 farmers use the herbicide paraquat to kill off weeds and crop residues after harvest. Hoes are also used to remove weeds and crop residues at this time. Herbicides are not necessarily used after every crop, but only when weed infestations are bad.

Pests and pest control

The diamond back moth larva was reported to be a serious insect pest on the farms visited but other insect pests are also important. All farmers have insecticide sprayers, either the shoulder type, which is hand operated, or a motorized type, with a stationary pump and portable hose and nozzle attachment. A great variety of chemical pesticides is used including, for example, Bayrusil (quinalphos), malathion and Tamaron (metamidophos). Spraying frequency varies according to the severity of the insect pest problem, the crop, and the weather, i.e., rainfall, and is usually from 2 - 7 days between sprayings. It is interesting to note in this context that the Singapore Primary Production Department (1974) recommended that pesticides should be sprayed once per week up to 10 days prior to harvesting, but during the wet season the number of sprays should be increased to twice per week.

Tan (1963: 175-176) reported that cutworms were the most common pests of vegetables, particularly of cabbages. He mentioned specifically: **Agrotis ypsilon** (black cutworm), **Prodenia litura** (tobacco cutworm), **Plutella maculipennis** (diamond back moth), **Hellula undalis** (cabbage web worm) and **Pieris rapae** (common cabbage worm or cabbage white). He also reported that modern insecticides had recently replaced derris as the main control against cutworms and these had brought a remarkable level of control. Lead arsenate had also been used as an insecticide in the past. Modern knapsack sprayers were also replacing simple tube and piston type sprayers. He noted that flea beetles, which had once been a major pest, were then completely under control.

Sanderson (1971) reported that **Plutella maculipennis** (diamond back moth) was a pest of Brassica crops and **Leucinoides orbinalis** was a pest of egg plant in Singapore. He also reported that aphids, leafhoppers and mites were insect pests.

Fan (1969: 79) reported that several kinds of insecticide were used at Lim Chu Kang including Phosdrin (mevinphos), Dipterex (trichlorfon), Basudin (diazinon), Tolly (?) and malathion.

Diseases and disease control

Little information was obtained on diseases and disease control as farmers considered the insect pest problem to be much more serious. However, the fungicide Dithane M45 (mancozeb) is sprayed, for example, every 3 - 5 days on one farm.

Sanderson (1971) reported that **Rhizoctonia solani**, (head rot of cabbage), **Choanephora cucurbitarum** (a fungal disease of peppers), Anthracnose of peppers and **Phytophthora** sp. (soft rot of egg plants) were important fungal diseases in Singapore. He also reported that **Erwinia caratovora** (soft rot of leafy vegetables) and **Pseudomonas solanacearum** (bacterial wilt of tomatoes and peppers) were important bacterial diseases. Tan (1963: 175) reported that the fungus

Rhizoctonia solani ("damping off") was a problem in nurseries, although fungicides had brought a remarkable level of control. Fan (1969: 98) reported that fungicides were used on some farms, including a zinc-fungicide, Ziram, and a copper-fungicide.

Harvesting and packing

Almost every day some vegetables on each farm are harvested and sold. Chinese kale is usually cut, whereas other leafy vegetables are usually pulled up and sold with their roots on. The Chinese spinach crop may have two harvests. In the first harvest the crop is cut and in the second the plants are pulled up together with their roots. Fruit vegetables are of course picked. The pulling up of flowering white cabbage, as the method of harvesting, was also reported by Tan (1963: 175) and Ng et al (1966: 182).

Whether the leafy vegetables are washed or not on the farms prior to marketing depends on arrangements made with the dealers. Some vegetables are washed, others are not. If they are washed, the washing is done in large metal bowls. If those with roots are not washed, the sand and soil is shaken off the roots. The harvested vegetables are packed into bamboo baskets on the farms, to facilitate easy handling and transportation to market.

CROP YIELDS

Yield per crop

Yield data were provided by 5 of the 7 farmers interviewed and these are set out in Table 5.3.

Table 5.3 Vegetable crop yields, Lim Chu Kang, Singapore.

Crop	Number of samples (1)	Range of yields, t/ha/crop (1)	Yield or ave. yield, t/ha/crop (1)	Average yield, t/ha/crop (2)
Flowering white cabbage	5	12.5-17.9	16.1	18.3
Chinese kale	3	10.7-20.0	15.1	12.4
Chinese spinach	5	13.2-34.1	21.9	19.3
Lettuce	2	10.0-20.0	15.0	12.5
Water spinach (dry bed)	4	12.5-25.6	19.1	16.0
Shallots/spring onions	1		19.7	
Eggplant	1	2.6- 3.4	3.0	

Source: 1. Fieldwork, 1981.

2. Suijkerbuijk (1982: 40).

Notes: (a) The mean of the average yields of flowering white cabbage, Chinese kale, Chinese spinach, lettuce and water spinach is 17.5 t/ha/crop according to the writer's fieldwork, or 15.7 t/ha/crop according to Suijkerbuijk (1982).

(b) Original yield data were provided on a per bed basis. In converting yield/bed to yield/hectare the area of both beds and footpaths has been included, in both the writer's and Suijkerbuijk's work.

(c) Regarding his yield data, Suijkerbuijk (1982: 19) noted that a number of Chinese kale and lettuce crops were of rather dubious quality. This could explain why the yields of these particular crops appear low.

Annual yield

By taking the mean of the average yields of the 5 main leafy vegetable crops, given in Table 5.3, as 17.5 t/ha/crop, and multiplying this mean by the average of 7.4 crops grown per year, then it can be estimated that the average annual yield of the farms visited is of the order of some 130 t/ha/year. Suikberbuijk (1982: 64) estimated average annual yields of 29 farms in Lim Chu Kang, growing the same 5 leafy vegetable crops, to be 110 t/ha/year, viz., 44.4 t/acre/year. These very approximate figures compare fairly closely with a similar annual yield figure reported by Blaut (1953: 45). He estimated the annual yield of one particular farm, specializing in leafy vegetable production, to be about 148 t/ha/year, viz., 66 short tons per cultivated acre of whole vegetables in the year 1952.

LABOUR USE

Labour used per hectare

The estimated amount of labour used on the 7 farms visited, based on full-time labour equivalents (see Appendix C) ranges from 3.1-6.7 persons/ha, with an average of 4.3 persons/ha.

Suijkerbuijk (1982: 57) estimated for 29 farms in Lim Chu Kang a theoretical labour requirement for the cultivation of 5 different kinds of leafy vegetable crops to be the equivalent of 3.7 persons/ha, viz., 1.5 mandays per acre per day Also in his study (p.22) he enumerated the actual number of farm workers to be the equivalent of 5.4 persons/ha, viz., 1.25 full-time + 0.95 part-time workers per net cultivated acre.

Farm labour is almost entirely provided by the farm family. Hired labour is seldom used, i.e., it is used just occasionally on one of the 7 farms only, and has therefore been omitted from the estimate. Fan (1969: 72) also found that farm labour was provided mainly by the farm family in the Lim Chu Kang area, and that no permanently hired labour was used, although some hired labour was used on a temporary basis for short and irregular periods during the year. Tan (1963: 177) reported that no hired labour was used.

Labour used per hectare per crop

Based on the numbers of crops grown per year on the 7 farms visited, the labour used ranges from 0.3 - 1.0 persons/ha/crop, with an average of 0.6 persons/ha/crop.

(B) A CASE STUDY OF THE CAMERON HIGHLANDS

CURRENT PRACTICES

Vegetable crops grown

The vegetable crops seen growing on the 4 farms visited in the Cameron Highlands were: flowering white cabbage, celery cabbage, cabbage, lettuce, celery, watercress, Chinese box thorn, sugar pea, tomato, onion and leeks. Discussions at MARDI, Tanah Rata, revealed that in addition to the crops seen, cauliflower, beans (several kinds) and cucumbers are also grown.

Lowe (1947: 5,8), describing vegetable production in the Cameron Highlands during the 1930's and 1940's, mentioned that the following crops were grown: cabbage, lettuce, dwarf beans, tomatoes, leeks, parsnips and turnips. Clarkson (1968: 80) included the following vegetables in a list of those grown in the Cameron Highlands in the 1960's: cabbages (Chinese and European), lettuce, celery, spinach, purslane, tomato, green (sweet) peppers, white (Chinese) radish, carrot, potato (white), sweet potato, and leeks. Ooi (1976: 292) reported that the vegetables grown in Chinese market gardens in the Cameron Highlands are those which cannot be produced commercially in the lowlands, but which grow well in the cooler environment of the highlands. In a list of vegetables grown in the Cameron Highlands, he includes many of those mentioned above, together with vegetable marrow, shallot, beetroot, asparagus and various herbs.

Planting methods

No information was collected by the writer on which crops are directly sown and which are transplanted. However, Clarkson (1968: 80) reported that many of the vegetables grown in the Highlands were transplanted after 35-40 days in a seed bed.

Interplanting

Interplanting is practised in the Cameron Highlands and several instances of it were seen, e.g., tomatoes interplanted with onions or leeks, celery interplanted with leeks, Chinese box thorn interplanted with flowering white cabbage, and celery cabbage interplanted with sugar peas.

Staggering of planting dates

No information was collected by the writer on staggering of planting dates. However, Clarkson (1968: 85,87) reported that farmers staggered planting in such a way that they would have a marketable crop almost every day. He presented a photograph of a field of cabbage showing different beds with the same crop at different stages of growth, viz., some beds prepared for planting, some beds with newly planted seedlings, some beds with cabbages ready for marketing, and some beds recently harvested.

Diversified cropping

A range of different leafy, fruit and root vegetable crops was seen growing at the same time in different fields of the same farms.

Field and bed layouts

In the Cameron Highlands the vegetable fields are terraced and levelled. On the steeply sloping land near Brinchang, the terraces are narrow; in some instances they are only wide enough to allow 1 or 2 rows of cabbage to be grown. Many of the terraces are only partially levelled, as this land has not previously been used for growing wetland rice under flooded field conditions. However, on the valley floor at Ringlet, some of the terraced fields are completely levelled and bunded, so as to facilitate the growing of watercress under flooded field conditions.

All of the vegetables grown, except watercress, are grown on raised beds The beds are 0.9-1.2 m wide, i.e., when measured across the top surfaces of the beds and omitting the footpaths between the beds, and 0.15-0.20 m high. The footpaths between the beds are about 0.30 m wide. Clarkson (1968: 79-80) reported typical beds as being 0.9m wide and 0.15m high, with their lengths varying with terrain and the size of the farmer's holding.

Cultivations

Land preparation is carried out by hand with hoes, and no mechanical cultivators are used.

The poor quality of the hill soils in the Cameron Highlands can be readily seen on the farms, most of which apart from those in the valley floors have little topsoil. Discussions at MARDI, Tanah Rata, revealed that some farmers have imported topsoil to the Highlands from other areas by truck.

Clarkson (1968: 87) reported that after harvest, the crop residues were removed, the beds were divided, and the soil was turned over onto what had been the narrow pathway between the old beds. This was done in order to form new beds for the next crop.

Trellising

Tomato and sugar pea crops were seen growing on simple trellises consisting of sticks and strings.

Organic fertilizers

Chicken manure is the main fertilizer used. It is brought up to the Highlands from lowland poultry farms, by the same trucks which transport vegetables down from the Highlands to the lowland urban markets. One farmer interviewed supplements the application of chicken manure with prawn dust. It was evident, both from general observation and from discussions at MARDI, Tanah Rata, that the application of chicken manure to the poor soils of the Cameron Highlands is the major factor sustaining continuous vegetable cropping on these soils.

Lowe (1947: 6-7) mentioned that prawn dust and fish waste were used as fertilizers, together with excreta (nightsoil?). Approximately, 15-30 t/ha/crop, for a 3 month cabbage crop, of prawn dust and fish waste were applied. Clarkson (1968: 80-83, 86) reported that prawn dust was the most common fertilizer used in the Highlands in the 1960's. It was made from the dried and crushed shells of prawns. It was formerly obtained from Indonesia, but latterly from India, i.e., after the Indonesian-Malaysian "Confrontation". It was applied in both liquid form, in watering cans after 30 days of fermentation in pits or jars containing water, and also in dry form, by placing it in planting holes as a basal dressing or broadcasting it as a top dressing. It was applied 4 times during each crop, twice to both seed beds and field beds. In addition to prawn dust, dried fish and soya bean cake were also used as fertilizers, in the same way as prawn dust. In earlier periods, nightsoil had been used extensively, but its use had declined in direct response to European repugnance towards that use.

Chemical fertilizers

Chemical fertilizers are used as a supplement to organic fertilizers. Urea, muriate of potash (60% K), and compound fertilizer, e.g., Nitrophoska, are applied.

Irrigation

Even though rainfall in the Cameron Highlands is relatively well distributed throughout the year, irrigation of vegetable crops is required during the short dry spells which occur. Irrigation water is supplied by small streams. Where possible, gravity flow is used for water distribution, but in some locations small pumps are used. On some farms water is stored in small sumps, some of which are lined with cement. Water is distributed to the fields through G.I. pipelines and flexible hoses. However, none of the farms have sprinkler irrigation systems.

Clarkson (1968: 66) reported that in the Cameron Highlands, where there is usually adequate year round rainfall, unlike the lowlands, viz., Singapore, the daily watering of vegetables by means of buckets is seldom necessary. Daily watering of vegetable beds in the Highlands, when rainfall has been unusually light or insolation unusually intense, was often accomplished by the diversion of natural streams into artificial channels. This water, sometimes impounded first in a small basin 0.9-1.2 m wide and about 0.6 m deep, on the slopes above the beds, was gravity-fed downslope to supply the necessary moisture to the beds.

Drainage

On all 4 farms the raised bed and footpath layout provides effective drainage during heavy rainstorms, the excess water running off along the footpaths between the beds and into drainage channels or stream courses.

Weeds and weed control

The vegetable fields all appear clean weeded.

Pests and pest control

Insect pests were reported to be a problem and some insect damage on cabbage leaves was observed in the fields. Farmers apply a variety of insecticides by means of portable hand-operated sprayers.

Harvesting and packing

Harvested vegetables are packed into bamboo baskets, to facilitate easy handling and transportation to market. Newspaper is used as a packing material for harvested vegetables put into the bamboo baskets.

CROP YIELDS

No information was obtained on this.

LABOUR USE

No information was obtained on this.

Field layouts on sloping land

Direct sowing by hand (Chinese spinach)

Staggered sowing dates (Chinese spinach)

Vegetable farming in Singapore

Plate 5.1

Trellising

(cucumber)

Chicken manure

store

Incorporating

chicken manure

with hoe

Vegetable

farming in

Singapore

Plate 5.2

Watering with hose

Drainage along footpaths during heavy rain

Tops of raised beds stay above water during heavy rain

Vegetable farming in Singapore

Plate 5.3

Weeding by hand (Chinese spinach)

Insecticide spraying (Chinese kale)

Harvesting (flowering white cabbage)

Vegetable farming in Singapore

Plate 5.4

Terraced fields on steeply sloping land

Indian farmer growing vegetables the Chinese way (Chinese box thorn)

Interplanting (sugar pea with celery cabbage)

Vegetable farming in the Cameron Highlands

Plate 5.5

CONCLUSION

In this chapter, data have been presented on the current practices, both traditional Chinese and modern Western, the crop yields and the labour use of vegetable farming in Singapore. Data on the current practices, both traditional Chinese and modern Western, of vegetable farming in the Cameron Highlands have also been presented. Analyses of these data will be presented in Chapters 7 and 8, on a comparative basis with data from other case study areas.

CHAPTER 6

CHINESE VEGETABLE FARMING PRACTICES IN THE PHILIPPINES: CASE STUDIES OF MANILA, CEBU AND BAGUIO

INTRODUCTION

This chapter focuses on the vegetable farming practices used in the Philippines, in particular in the Manila, Cebu and Baguio areas, the locations of which are shown in Figure 3.3. The current practices used in these areas consist mainly of traditional Chinese and modern Western practices. Information on the physical and human environments of vegetable farming in these areas is given in Chapter 3.

Most of the information presented in this chapter was obtained during the writer's fieldwork in Manila in March 1981, in Cebu in December 1981 and in Baguio in April 1981. In the course of the fieldwork 9 farmer interviews were conducted, 3 in Manila, 2 in Cebu and 4 in Baguio. Where available, comparable and confirmatory information from previous literature is also presented in this chapter, in the relevant sections.

(A) A CASE STUDY OF MANILA

CURRENT PRACTICES

Vegetable crops grown

The vegetable crops grown on the 3 farms visited are listed in Table 6.1. The crops most commonly grown, i.e., those grown on 2 or more of the farms, are Chinese white cabbage, leaf mustard, lettuce, celery

Table 6.1 Vegetable crops grown, sample durations and planting methods, Manila.

Crops grown	Seed bed period, days (1)	Transplanting to harvest, days (1)	Total duration, days (1)	Planting method (1)	Duration in field beds, days (2)	Planting method (2)
Leafy vegetables						
Chinese white cabbage	15	15-20	30-35	T		
Leaf mustard	15	15-20	30-35	T	20-30	T
Chinese spinach			15	DS	25-35	DS
Lettuce	15	15-20	30-35	T	20-30	T
Celery			60	T	30-45	T
Water spinach			15	DS		
Fruit vegetables						
Sweet peppers						
Root vegetables						
Common (bulb) onion			90-100			
Spring onion		30		T	60-70	T
Taro						

Sources: 1 Fieldwork, 1981.

2 Santiago (1980: 4, 9-12).

Notes: (a) All time periods are given in days, rounded to the nearest 5 days.

(b) DS = Directly sown. T = Transplanted.

(c) In data taken from Santiago (1980), nursery periods of transplanted crops were as follows: lettuce 25 days, leaf mustard 15 days, and spring onions and celery 40 days.

and water spinach. Santiago (1980: 9), describing an 0.5 ha vegetable farm in Pasay, reported a similar list of crops grown.

Intensity of cropping

On the 3 farms visited, 9-12 crops per year are grown on the same beds, with an average of 11 crops per year. Santiago (1980: 10) considered in a 'safe' estimate that 5 crops were grown per bed per year, but this seems to be rather too low an estimate, bearing in mind the short periods of time that the crops occupy the field beds.

Crop durations

Information on crop durations obtained from the 3 farms is given in Table 6.1. In general, leafy vegetables are of short duration and they only occupy the field beds for 15-45 days, apart from celery.

Planting methods

Most leafy vegetables are sown in nurseries and transplanted, as can be seen from Table 6.1. Chinese spinach and water spinach are directly sown, though.

Interplanting

Interplanting is not practised.

Staggering of planting dates

No information was obtained on this, but on the same farms the same leafy vegetable crops were seen at different stages of growth on different field beds.

Diversified cropping

A range of different, mainly leafy, vegetable crops was seen growing at the same time in different fields of the same farms.

Rotations

Crop rotation is practised, but no regular pattern is followed. The same crop is not planted continuously on the same bed.

Field and bed layouts

The fields of the 3 farms visited, which are laid out on flat to gently sloping land, are unterraced, unlevelled and unbunded. Low raised beds are constructed with footpaths between each bed to provide access to crop plants and adquate drainage. Bed dimensions vary slightly from farm to farm. When measured from centre to centre, i.e., including half of the footpath around each bed, the typical dimensions are as follows: width 1.2 m, height 0.1 m, and length 9.0 m, approximately. On 2 of the farms the edges of the seed beds are slightly raised so as to form low rims, which help to retain irrigation water during and immediately after application with buckets.

Cultivations

Land preparation for vegetable crops is carried out by hand with hoes on 2 of the 3 farms visited. On the third farm, at Santa Rosa, a tractor drawn plough and also a water buffalo drawn plough are used as well as hoes. Hoeing is carried out between each crop grown on the 3 farms, although ploughing is carried out sometimes on 1 farm. Similarly, Santiago (1980: 10) reported that land preparation was done with hoes and rakes.

Mulching

Rice straw is used to mulch seed beds of celery and onions on 2 of the farms visited. Santiago (1980: 13) also reported the use of rice straw for mulching celery and spring onions.

Trellising

No trellising was seen on the 3 farms visited, as trellis crops are not grown on these farms.

Organic fertilizers: materials and preparation

Chicken manure is the main type of organic fertilizer used on the 3 farms visited, and is bought from other farms in dry form (sun dried). "Lumbang" (**Aleurites** spp.) oil-seed cake is also used as an organic fertilizer on 2 of the farms. Santiago (1980: 2) reported that chicken manure, lumbang oil-seed cake and kapok (**Ceiba pentandra**) oil-seed cake are used as organic fertilizers in the Pasay area. Both lumbang and kapok oil-seed cake are the pressed seeds remaining after oil extraction.

Organic fertilizers: application rates

Information on application rates was provided by one of the farmers. Expressed in metric units, the application rates of chicken manure and oil-seed cake were 4.2 and 1.4 t/ha/crop, respectively, on his farm. A scrambled application rate for these two different kinds of fertilizer would be 5.6 t/ha/crop. Based on the number of crops grown per year, on this farm of 12, the scrambled annual application rate amounts to some 67 t/ha/year.

Organic fertilizer: application timing and placement

The timing of organic fertilizer application was reported to vary from 1-3 times per crop on the 3 farms visited.

Chemical fertilizers

Very little chemical fertilizer is used on the 3 farms visited. One farmer uses none at all apart from a little compound fertilizer (NPK -14:14:14) on bulb onions, another only uses a little nitrogenous fertilizer when his crop plants, mainly leafy vegetables, appear too yellow in colour, and the third uses just a little of the nitrogenous fertilizer ammonium sulphate as a top dressing. Santiago (1980: 11) reported the use of a small amount of urea as a top dressing.

Irrigation

The 3 farms visited have wells and deep sumps, fed by underground water, which supply the farms with irrigation water. Bucket watering is carried out on the 3 farms, with pairs of buckets filled in the sumps. On a part of one of the farms a flexible hose, fed by a diesel pump, is used for watering field beds. Bucket watering is carried out up to 4 times per day. The same bucket and sump irrigation method was reported by Santiago (1980: 13), with the same frequency of bucket watering of 3-4 times per day.

Drainage

On all 3 farms the raised bed and footpath layout provides effective drainage during heavy rainstorms, the excess water running off along the footpaths between the beds and into drainage channels or farm sumps.

Weeds and weed control

The vegetable fields all appear clean weeded. Most crops are hand weeded during crop growth. No herbicides are applied at any time. Santiago (1980: 13) reported that a knife is used for weeding.

Pests and pest control

Insect pests were reported to be a problem. Various chemical insecticides are applied, including endrin, Phosdrin (mevinphos), Sumithion (fenitrothion), malathion, and Sumicidin (fenvalerate). Santiago (1980: 17) reported the use of the following insecticides: Folidol (methyl parathion), malathion, Thiodan (endosulfan), Hostathion (triazophos), Gusathion (azinphosethyl). He also reported that spraying was mainly done to control insect pests rather than diseases.

Diseases and disease control

No information was collected on this.

Harvesting and packing

Vegetables are harvested by hand on a daily basis, continuously throughout the year.

CROP YIELDS

No information was collected on yield per crop or annual yield.

Santiago (1980: 14) estimated average crop yields as follows: lettuce 20-30 kg/plot, leaf mustard 12-25 kg/plot, celery 17-37 kg/plot, spring onions 17-45 kg/plot. As the average plot size was 10 square metres (there were 475 plots on 0.475 ha of land) then these same figures equate to yields expressed in t/ha/crop. The lower figure in the range was the wet season yield, the higher figure was the dry season yield.

LABOUR USE

Labour used per hectare

The estimated amount of labour used on the 3 farms visited, based on full-time labour equivalents (see Appendix C), ranges from 5.7 - 11.0 persons/ha, with an average of 8.1 persons/ha.

Farm labour on 2 of the farms is provided entirely by hired farm labour supervised by a farm manager/foreman. On the third farm, a particularly small farm, all the labour is provided by the farmer himself.

Santiago (1980: 15) reported that on the 0.5 ha farm he studied in Pasay, farm labour was provided by the farmer, 4 full-time hired labourers and the farmer's son. Hence, labour used per hectare on this farm was 12 persons/ha.

Labour used per hectare per crop

Based on the numbers of crops grown per year on the 3 farms visited, the labour used ranges from 0.5 - 1.2 persons/ha/crop, with an average of 0.8 persons/ha/crop.

(B) A CASE STUDY OF CEBU

CURRENT PRACTICES

Vegetable crop grown

The vegetable crops grown on the 2 farms visited are listed in Table 6.2. The crops most commonly grown, i.e., those grown on both of the farms, are flowering white cabbage, Chinese white cabbage, leaf mustard, cauliflower, Chinese spinach, lettuce, water spinach and eggplant.

Intensity of cropping

Information provided by the 2 farmers visited indicated that on one of the farms about 8 crops per year are grown, whereas on the other farm 4-18 crops per year are grown depending on the particular crops, viz., eggplants intercropped with Chinese white cabbage gives 4 crops per year, whereas the sequential growing of transplanted leafy vegetables gives up to 18 crops per year. On the basis of these figures, it may be conservatively estimated that on average some 9.5 crops per year are grown on these farms, that is by assuming 8 and 11 crops per year for the 2 farms respectively.

Crop durations

Information on crop durations obtained from the two farms is given in Table 6.2.

Table 6.2 Vegetable crops grown, sample durations and planting methods, Cebu.

Crops grown	Seed bed period, days	Transplanting to harvest, days	Total duration, days	Planting method
Leafy vegetables				
Flowering white cabbage				DS/T
Chinese white cabbage		20-30		T
Chinese kale				
Leaf mustard		20		T
Cauliflower		45		T
Chinese spinach				
Lettuce				T
Celery				DS
Water spinach				DS
Spinach				
Chinese chives				T
Fruit vegetables				
Wax gourd				
Eggplant				T

Source: Fieldwork, 1981.

Notes: (a) All time periods are given in days, rounded to the nearest 5 days.

(b) DS = Directly sown. T = Transplanted.

Planting methods

Most leafy vegetables are sown in nurseries and transplanted, as can be seen from Table 6.2. However, celery and water spinach are directly sown. Sometimes, flowering white cabbage is also directly sown.

Interplanting

Interplanting is occasionally practised on the 2 farms. For example, Chinese chives are interplanted with lettuce, cauliflower is interplanted with flowering white cabbage or Chinese white cabbage, and eggplant with Chinese white cabbage. In all these examples, longer duration crops are interplanted with shorter duration crops. However, only one of these examples was actually seen, viz., Chinese chives with lettuce.

Staggering of planting dates

No information was obtained on this, but on the same farms the same leafy vegetable crops were seen at different stages of growth on different field beds.

Diversified cropping

A range of different, mainly leafy, vegetable crops was seen growing at the same time in different fields of the same farms.

Rotations

Crop rotation is practised, but no regular pattern is followed. One farmer reported that the rotation pattern followed varies according to soil conditions, market demand and labour availability. Usually the same crop is not planted continuously in the same bed, but on one farm Chinese white cabbage is grown 3 times in succession before the rotation continues with other crops.

Field and bed layouts

The fields of the 2 farms visited, which are laid out on more or less flat land, are unbunded. Low raised beds are constructed with footpaths between each bed to provide access to crop plants and adequate drainage. Typical bed dimensions when measured from centre to centre, i.e., including half of the footpath around each bed, are as follows: width 1.0 m, height 0.1 m and length 10-22m, approximately. Higher beds, 0.3 m high, are raised up for eggplant. The edges of seed beds are slightly raised so as to form low rims, as on the farms visted in Manila.

Cultivations

Land preparation for vegetable crops is carried out with water buffalo drawn ploughs, hoes and rakes.

Mulching

Rice straw is used to mulch seed beds.

Trellising

No trellising is used on the 2 farms visited, as trellis crops, apart from wax gourd, are not grown. On the one farm where wax gourd is grown, it is allowed to sprawl on the ground.

Organic fertilizers

Chicken manure is used on one of the farms visited and kapok oil-seed cake (kapok seed after oil extraction) is used on the other farm. The chicken manure is applied at a rate of 13 t/ha/year. The kapok oil-seed cake is applied at a rate of one handful per plant; the farmer was not able to provide further detail.

Chemical fertilizers

Ammonium sulphate, urea and compound fertilizer (NPK - 14:14:14) are used. One farmer, the same one who applies chicken manure, provided application rates which expressed in t/ha/year are as follows: ammonium sulphate 1.0, urea 0.5 and compound 0.75, giving a combined application rate of 2.25 t/ha/year. The average application rate per crop, based on the number of crops grown per year on this farm of 11, is 0.2 t/ha/crop.

No lime is applied on these farms, which are located on calcareous soils.

Irrigation

The 2 farms visited have sumps, about 2 m deep, fed by underground water, which supply the farms with irrigation water. Bucket watering is carried out on the 2 farms, with pairs of buckets filled in the sumps. Water is applied 4-6 times per day in dry weather.

Drainage

On both farms the raised bed and footpath layout provides adequate drainage during heavy rainstorms, the excess water running off along the footpaths between the beds and into drainage channels or farm sumps. On one farm an open earth field drain had been constructed, which was 1 m deep, 2 m wide at the top and 0.5 m wide at the bottom; this large drain passes through the middle of the farm.

Weeds and weed control

The vegetable fields all appear clean weeded. Crops are hand weeded during crop growth, the weeds being either pulled up or cut with a knife ("bolo"). No herbicides are applied at any time.

Pests and pest control

Butterfly larvae and diamond back moth **(Plutella xylostella)** were reported to be insect pest problems. Various chemical insecticides are applied, including Kafil (?), Tamaron (metamidophos), Folidol (methyl parathion), malathion, Lannate (methomyl) and Lusithion (?). Spraying frequency of insecticides varies from 1 time per crop up to 2 times per week, depending on the severity of the insect pest attack.

Diseases and disease control

No information was obtained on disease problems, but both farmers reported that they do not use fungicides.

Harvesting and packing

Leafy vegetables are pulled up with their roots, except for some large plants which are cut. Fruits of eggplants are picked. Vegetables are washed before being packed into bamboo baskets, which facilitates handling and transportation to market.

CROP YIELDS

Yield per crop

Yield data reported by the 2 farmers visited are given in Table 6.3. No information was obtained concerning the yield variation between interplanted crops and crops grown as pure stands, nor between wet and dry season crops.

Annual yield

No information was obtained on the total annual yield of crops on a per hectare basis. However, assuming that on average 9.5 different crops per year are grown, a very approximate estimate of annual yield may be obtained by summing the yields of the 9 crops listed in Table 6.3. The sum of the yields of these 9 crops is 135.5 t/ha. Hence, with 9.5 crops per year, the annual yield amounts to around 140 t/ha/year.

LABOUR USE

Labour used per hectare

The estimated amount of labour used on the 2 farms visited, based on

Table 6.3 Vegetable crop yields, Cebu.

Crop	Number of samples	Range of yields, t/ha/crop	Yield or average yield, t/ha/crop
Flowering white cabbage	2	7.7 - 15.4	13.3
Chinese white cabbage	2	15.4 - 23.1	19.6
Leaf mustard	2	15.4 - 26.9	20.6
Cauliflower	2	11.5 - 38.5	27.5
Chinese spinach	1	15.0	15.0
Lettuce	2	10.0 - 15.4	11.7
Celery	1	10.0	10.0
Water spinach (dry bed)	2	15.0 - 23.1	19.1
Eggplant	1	8.7	8.7

Source: Fieldwork, 1981.

full-time labour equivalents (see Appendix C), ranges from 4.7 - 5.6 persons/ha, with an average of 5.2 persons/ha.

Farm labour on one of the farms is provided by the farmer and 3-4 part-time hired labourers and on the other farm by the farmer and 8 full-time hired labourers.

Labour used per hectare per crop

Based on the numbers of crops grown per year on the 2 farms visited, the labour used ranges from 0.4 - 0.7 persons/ha/crop, with an average of 0.6 persons/ha/crop.

(C) A CASE STUDY OF BAGUIO

CURRENT PRACTICES

Vegetable crops grown

The vegetable crops grown on the 4 farms visited are listed in Table 6.4. The crops most commonly grown, i.e., those grown on 2 or more of the farms, are celery cabbage, cabbage, lettuce, sugar pea and potato. Most of these vegetables are mid-latitude, i.e., temperature zone, vegetables, as opposed to low-latitude, i.e., tropical zone, vegetables.

Intensity of cropping

On the 4 farms visited 2-4 crops per year are grown on the same beds, with an average of 2.8 crops per year.

Table 6.4 Vegetable crops grown, sample durations and planting methods, Baguio.

Crops grown	Seed bed period, days	Transplanting to harvest, days	Total duration, days	Planting method
Leafy vegetables				
Flowering white cabbage				
Chinese white cabbage				T
Celery cabbage		60 - 90		T
Chinese kale				
Cabbage				T
Cauliflower		60		T
Sprouting broccoli				
Lettuce	15 - 30	50 - 75		T
Celery		60 - 75		T
Fruit vegetables				
Bean (kind unspecified)				
Sugar pea			60 - 90	DS
Cucumber				
Sweet peppers				
Tomato				
Root vegetables				
Common onion (bulb)				
Potato				DS
Taro				

Source: Fieldwork, 1981.

Notes : (a) All time periods are given in days, rounded to the nearest 5 days.

(b) DS = Directly sown. T = Transplanted.

Crop durations

Information on crop durations obtained from the 4 farms is given in Table 6.4. Comparison of Table 6.4 with Tables 6.1 and 6.2 shows that the same crops, e.g., cauliflower, lettuce and celery, grow considerably more slowly, i.e., have a longer duration, in the highlands than in the lowlands, because of the lower temperatures experienced in the highlands. This factor effectively decreases the number of crops that can be grown per year in the highlands.

Planting methods

Leafy vegetables are generally sown in nurseries and transplanted, as can be seen from Table 6.4. Sugar pea and potato crops are directly sown. On one farm lettuce is transplanted twice, firstly at 14 days on a 2 inch spacing, and secondly at 28 days on a 4 or 8 inch spacing.

Interplanting

Interplanting is not usually practised, except on one farm where sugar pea is sometimes interplanted with lettuce, but this was not seen by the writer. However, occasionally on the ends of field beds, bulb onions and taro are planted so as to make best use of available space in the fields.

Staggering of planting dates

No information was obtained on this.

Diversified cropping

A wide range of different leafy, fruit and root vegetable crops was seen growing at the same time in different fields of the same farms.

Rotations

Crop rotation is practised, and set patterns were reported by the 4 farmers. Typical rotations, covering a period of one year, on the 4 different farms, are as follows:

(a) lettuce, celery, cauliflower, sugar pea - 4 crops/year;

(b) lettuce or celery cabbage, sugar pea, fallow (owing to seasonal water shortage) - 2 crops/year;

(c) lettuce, celery or celery cabbage, potato - 3 crops/year;

(d) potato, cabbage - 2 crops per year (Mountain Trail farm, at Madayman).

Field and bed layouts

The fields of all 4 farms visited are terraced, levelled and bunded. The fields of the 3 farms in La Trinidad are located on gently sloping valley floor land. They were originally laid out as paddy fields for growing wetland rice. In contrast, the fields of the farm in Mountain Trail are located on steeply sloping land. They were laid out for vegetable growing, but were terraced, levelled and bunded in order to prevent soil erosion; many of them though were only partially levelled.

Low raised beds are constructed with footpaths between each bed to provide access to crop plants and adequate drainage. Bed dimensions vary slightly from farm to farm. When measured from centre to centre, i.e., including half of the footpath around each bed, the typical dimensions are as follows: width 1.0 - 1.5 m, height 0.10 - 0.15 m, and length 8.5 - 24.0m.

Cultivations

Land preparation for vegetable crops is carried out by hand with hoes, both bladed and forked types, on all 4 farms visited.

Mulching

Dried "Cogon" grass (**Imperata cylindrica**) is used to mulch both seed beds and field beds on the 3 farms in La Trinidad, particularly during the rainy season. On one of the farms, coconut matting and old sacks are also used to mulch seed beds. However, on the farm in Mountain Trail, no mulch is used.

Overhead protection of seed beds

On 2 of the farms, seedlings are sown in nursery beds covered by protective frames, rather like open-sided greenhouses, which give protection against damage caused by heavy rain.

Trellising

Trellises of bamboo are constructed for the sugar pea crop.

Organic fertilizers: materials and preparation

Chicken manure is the main type of organic fertilizer used on the 4 farms visited. It is brought up to the highlands from lowland poultry farms, by the same trucks which transport vegetables from the highlands to the lowland urban markets. It is transported and used in dry form. On the farm in Madayman, Mountain Trail, the farmer supplements the use of chicken manure with a little composted cattle manure, produced on his own farm by composting the manure with weeds for a period of 1-3 months.

Organic fertilizers: application rates

Quantitative information on application rates of chicken manure was provided by 3 of the farmers. Expressed in metric units, the application rates of chicken manure varied widely from 3.0 - 46.9 t/ha/crop, with an average application rate of 12.7 t/ha/crop. The other farmer reported applying chicken manure at a rate of one handful per plant. Based on the numbers of crops grown per year on the 3 different farms, the annual application rates range from 6-87 t/ha/year, with an average of 40 t/ha/year. Sano (1977: 43) reported that chicken manure is commonly applied by vegetable growers in Benguet, the province in which the 4 farms visited are located, at a rate of 8-15 t/ha/crop in the case of the potato crop.

Organic fertilizer: application timing and placement

The timing of chicken manure application was reported to vary from 1-2 times per crop, more usually once per crop as a basal dressing. It usually is applied as one handful per plant and placed in small holes in the field beds just prior to planting of the crop. Any subsequent application is applied as a top or side dressing.

Chemical fertilizers

Urea is applied on one of the farms, but compound fertilizer (N:P:K - 14:14:14) is applied on all 4 of the farms visited.

Urea is applied at a rate of 0.35 t/ha/crop, once per crop as a top dressing 2 weeks after transplanting. Compound fertilizer is applied at rates ranging from 0.29 - 0.67 t/ha/crop, with an average of 0.49 t/ha/crop, 1-2 times per crop as a basal and also as a top dressing. When applied as a basal dressing it is often mixed with chicken manure. Based on the numbers of crops grown per year on the different farms, the annual application rate amounts to an average of 1.4 t/ha/year of urea (1 farm only) and 1.4 t/ha/year of compound fertilizer (3 farms). Combined average application rates, for both urea and compound fertilizer together, are 0.6 t/ha/crop and 1.9 t/ha/year. Sano (1977: 56) reported that the compound fertilizers 15:15:15, 14:14:14 and 12:12:12 were used on the potato crop. The first two were usually applied at a rate of 1.5 - 1.75 t/ha/crop, under agricultural college conditions.

No information was obtained on whether or not lime is applied on the 4 vegetable farms visited. However, Sano (1977) did not report its use on the potato crop in Benguet.

Irrigation

The 4 farms visited are supplied with water by wells and streams. Bucket watering is carried out on the 3 farms in La Trinidad, with buckets made from 19 litre kerosene cans. These buckets are carried in pairs, suspended from a stick supported on the farmer's shoulders. One of the 3 farms also has a diesel pump which pumps water into an unlined channel, by means of which irrigation water is distributed to the fields. Bucket watering is carried out 1-4 times per day, depending on the weather and the age of the crop, young transplants receiving water more frequently. Seedlings are watered with special bucket watering cans fitted with fine roses. Sano (1977: 60) also reported the use of bucket watering on the potato crop in Benguet, but in addition he reported that watering by furrow irrigation was carried out when water supply was sufficient.

Drainage

On all 4 farms the raised bed and footpath layout provides effective drainage during heavy rainstorms, the excess water running off along the footpaths between the beds and into drainage channels.

Weeds and weed control

The vegetable fields all appear clean weeded. Crops are hand weeded during crop growth, the weeds being either pulled up or cut by a chisel or a small sickle. No herbicides are applied at any time.

Pests and pest control

Many insect pests were reported to be problems. Diamond back moth, cutworms and beetle larvae are pests of leafy vegetables. Stink bug is a pest of cucumber and tuber moth and aphid, which transmit a virus disease, are pests of potato. Insect pest problems were reported to be worse in the dry season, than in the wet season. Various chemical insecticides are applied, including Kafil (?), Vegetox (cartap), Tamaron (metamidophos) and Sumicidin (fenitrothion). Also applied is Dipel (**Bacillus thuringiensis**), a bacteria used for biological control of insect pests. Insecticides are applied with portable sprayers. Sano (1977: 61) reported that tuber moth, aphid, army worms and cutworms were pests of potato, and insecticides were sprayed.

Diseases and disease control

Various disease problems were reported, including downy mildew on cabbage and lettuce, soft rot on lettuce, powdery mildew on sugar pea and late leaf blight on tomato. Fungal diseases were reported to be worse in the wet seasons than in the dry season. Several fungicides are applied, including Manzate (maneb), Daconil (chlorothalonil) and Dithane M45 (mancozeb).

Sano (1977: 61) reported that late blight and early blight were diseases on potato, and fungicides were sprayed at intervals of 5-12 days, according to season and potato variety.

Harvesting and packing

Vegetables are harvested by hand by cutting, picking or digging up, depending on the crop, and packed into bamboo baskets, which facilitate handling and transportation to market.

CROP YIELDS

Yield per crop

Yield data reported by the 4 farmers visited are given in Table 6.5.

Table 6.5 Vegetable crop yields, Baguio.

Crop	Number of samples	Range of yields, t/ha/crop	Yield or average yield, t/ha/crop
Chinese white cabbage	1	8.3 - 18.3	13.3
Celery cabbage	1	23.5	23.5
Cabbage	1	30.0	30.0
Cauliflower	1	23.5	23.5
Lettuce	3	8.3 - 47.0	27.9
Celery	1	70.6	70.6
Sugar pea	2	8.2 - 11.8	10.9
Cucumber	1	47.0 - 58.8	52.9
Sweet peppers	1	11.8	11.8
Potato	2	12.0 - 47.0	30.5

Source: Fieldwork, 1981.

Sano (1977: 66) reported the average yield per crop of potato to be 20 t/ha/crop, under La Trinidad Valley conditions in 1973-74.

Annual yield

No information was obtained on the total annual yield of crops on a per hectare basis.

LABOUR USE

Labour used per hectare

The estimated amount of labour used on the 4 farms visited, based on full-time labour equivalents (see Appendix C), ranges from 1.0 - 5.0 persons/ha, with an average of 2.9 persons/ha.

Farm labour on the farms is provided mainly by the farmers and hired labour, with just a little help from the farmers' families.

Labour used per hectare per crop

Based on the numbers of crops grown per year on the 4 farms visited the labour used ranges from 0.3 - 2.5 persons/ha/crop, with an average of 1.2 persons/ha/crop.

Field layouts

Land preparation

with hoe

Transplanting

Vegetable

farming in

Manila

Plate 6.1

Chicken manure (Chinese white cabbage)

Filling buckets in sump

Bucket watering

Vegetable farming in Manila

Plate 6.2

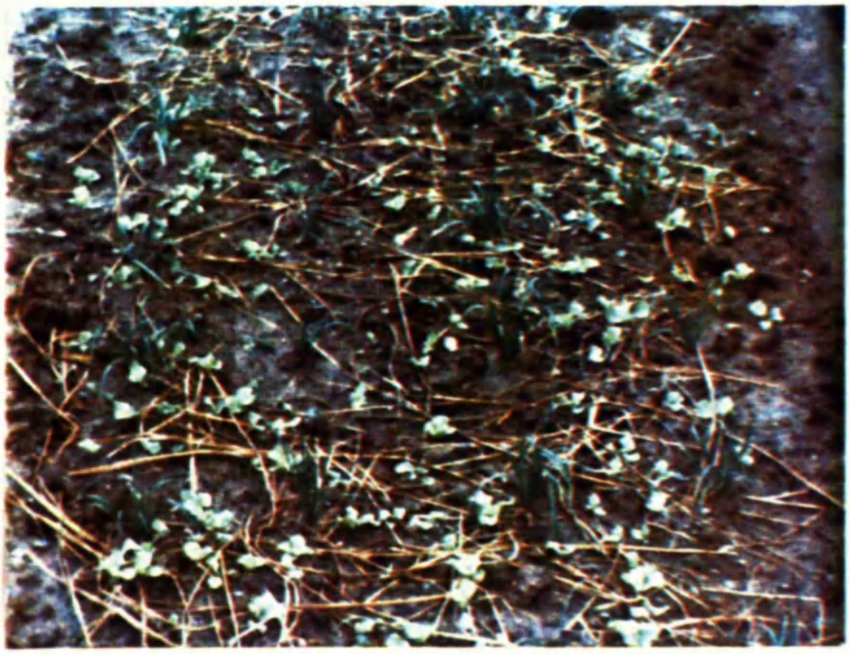
Field layouts
and farmhouse

Raised beds
(water spinach)

Mulching of seed
beds with rice
straw

Vegetable farming in Cebu

Plate 6.3



Interplanting (Chinese chives with lettuce)

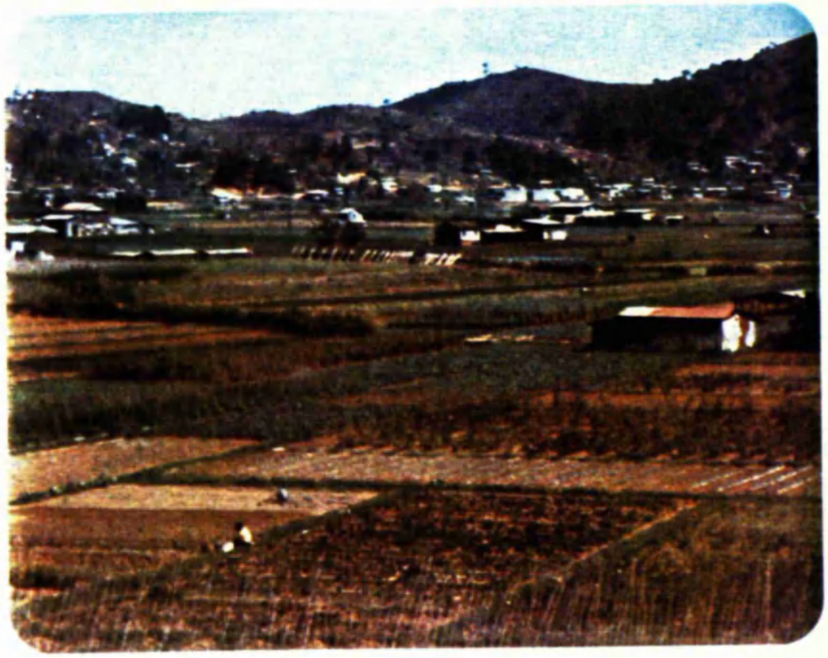
Buckets for watering

Harvesting (Chinese white cabbage)

Vegetable farming in Cebu

Plate 6.4

Vegetable farms in La Trinidad Valley



Raised beds and trellising (sugar peas)

Transplanting (lettuce)

Vegetable farming in Baguio

Plate 6.5

Range of implements used in vegetable farming

Vegetable farm at Madayman, Mountain Trail (cabbage)

Unloading chicken manure for highland farms

Vegetable farming in Baguio

Plate 6.6

CONCLUSION

In this chapter, data have been presented on the current practices, both traditional Chinese and modern Western, the crop yields and the labour use of vegetable farming in Manila, Cebu and Baguio. Analyses of these data will be presented in Chapters 7 and 8, on a comparative basis with data from the other case study areas.

CHAPTER 7

A COMPARATIVE ANALYSIS OF THE USE OF TRADITIONAL CHINESE VEGETABLE FARMING PRACTICES IN SOUTHEAST ASIA

INTRODUCTION

This chapter focuses on the question of whether or not the traditional vegetable farming practices of South China can be successfully used in Southeast Asian environments. The specific aim of the chapter is to show that they have already been successfully used in a number of different vegetable farming environments in Southeast Asia in the recent past.

To show this it is necessary, first of all, to clearly identify the different types of vegetable farming environment in the case study areas of Southeast Asia. Having done so, it is then possible to assess the extent to which traditional Chinese vegetable farming practices are currently used, or have been used in the recent past, in those different types of environment.

Having made this assessment, if it is found that most of the practices are currently used, or have been used in the recent past, in all of the different types of environment, then it could be concluded that the practices in general have already been successfully used in those environments. If, however, it is found that most of the practices are not currently used, or have not been used in the recent past, in all of the different types of environment, then it would have to be concluded that the practices in general have not been successfully used in those environments. The aim of this chapter though, is to show that the practices have been successfully used in those environments.

TYPES OF ENVIRONMENT

Information on the environments of all the case study areas is presented in Chapters 1 - 3. The first part of this present chapter involves a comparative analysis of these environments, both physical and human, in order to help identify the different types of vegetable farming environment in Southeast Asia and to show up similarities and differences between those of Southeast Asia and those of South China.

Physical Environments

In Table 7.1 the physical environments of the case study areas are compared, in terms of relief, natural drainage, climate and soils.

In terms of relief, two types of area may be distinguished. There are lowland areas, below say, 100m, and highland areas, above say, 1,000m. The lowland areas are Canton, Hong Kong, Bangkok, Singapore, Manila and Cebu. The highland areas are the Cameron Highlands and Baguio. The landforms most associated with the lowland areas are deltas and plains, with the exception of a part of the Hong Kong area and Singapore which consist of hills and valleys. The landforms associated with the highland areas are hills and valleys only. The lowland areas are usually flat or have gentle to moderate slopes, whereas the highland areas have gentle to steep slopes.

In terms of natural drainage, two types of area may also be distinguished. There are some areas with poor natural drainage and other areas with good natural drainage. Areas with poor natural drainage are the flat deltaic part of the Canton area, the flat low-lying part of the Hong kong area and the flat deltaic area of Bangkok. Areas with good natural drainage are the sloping parts of the Canton and Hong Kong areas and all of the other case study areas,

Table 7.1 Comparison of the physical environments of case study areas.

		Canton	Hong Kong	Bangkok	Singapore	Cameron H'lands	Manila	Cebu	Baguio
Latitude, °N		23	22	14	1	5	15	10	16
Relief									
Altitude	Lowland (0-100m)	●	●	●	●		●	●	
	Highland (1000m+)					●			●
Landform	Delta	●		●					
	Plain		●				●	●	
	Hills & valleys		O		●	●			●
Slope	Flat	●	O	●			●	●	
	Gentle-moderate	O	●		●		O	O	●
	Steep					●			O
Natural Drainage									
	Poor	●	O	●					
	Good	O	●		●	●	●	●	●
Climate									
Type	Monsoon	●	●						
	Tropical monsoon			●			●	●	
	Equatorial				●				
	Highland					●			●
Seasons	Cool DS, warm RS	●	●						
	Warm DS, warm RS			●			●	●	
	Warm/rainy all yr				●				
	Cool/rainy all yr					●			
	Cool DS, cool RS								●
Typhoons	None				●	●			
	Some	●	●	●				●	
	Many						●		●
Temp.	Av.monthly, °C	22	22	28	27	19	27	27	19
	Mthly range, °C	15	13	6	1	1	4	2	3
Rainfall	Av. annual, mm	1600	2200	1400	2400	2600	2100	1600	5000
Soils									
Type	Heavy (clays)			●	O	O	O		
	Medium (loams)	●	●		●	●	●	●	●
	Light (sands)		O		O	O			

Source: Chapters 1-3.
Note: Key: ● = All or most parts of case study area
O = Some parts of case study area
DS = Dry season, RS= rainy season.

viz., Singapore, Cameron Highlands, Manila, Cebu and Baguio.

When relief and natural drainage are considered together, it is possible to identify three distinct types of area, as follows:

(i) Lowland areas with poor natural drainage, viz., Canton (part), Hong Kong (part), and Bangkok;

(ii) Lowland areas with good natural drainage, viz., Canton (part), Hong Kong (part), Singapore, Manila and Cebu;

(iii) Highland areas with good natural drainage, viz., Cameron Highlands and Baguio.

The types of climate experienced by the case study areas are very varied. They are related to both relief, or more specifically altitude, and latitude. Canton and Hong Kong, which are lowland areas with latitudes of 23 ^{o} and 22 ^{o} N experience monsoon climates with distinct cool and warm seasons. In contrast, the Southeast Asian areas, comprising both lowland and highland areas with latitudes ranging from 16 - 1 ^{o} N, experience a wide range of different climates. The lowland areas of Bangkok at 14 ^{o} N, Manila at 15 ^{o} N and Cebu at 10 ^{o} N experience tropical monsoon climates with distinct warm dry seasons and warm rainy seasons. The lowland area of Singapore at 1 ^{o} N experiences an equatorial climate with warm and rainy weather throughout the year. The highland areas of the Cameron Highlands at 5 ^{o} N and Baguio at 16 ^{o} N experience highland climates. In the case of the Cameron Highlands, at the lower latitude, the climate is cool and rainy throughout the year, whereas at Bagiuo, at the higher latitude, the climate has distinct cool dry and cool rainy seasons.

In contrast to Canton and Hong Kong, the case study areas in Southeast Asia are either warm throughout the year or cool throughout the year. Average mean monthly temperature in the warm areas is 27 ^{0} C and in the cool areas is 19 ^{0} C. In both warm and cool areas the mean monthly temperature range is slight and does not exceed 6 ^{0} C. Canton and Hong Kong though have average mean monthly temperatures of 22 ^{0} C and marked mean monthly temperature ranges of 15 ^{0} and 13 ^{0} C, which show the extent of temperature variation between the cool and warm seasons. The significance of these different temperature regimes lies in their effects on the types of vegetable crops grown in the different areas. In the warm areas, or in Canton and Hong Kong during the warm season, tropical types of vegetables are most frequently grown, whereas in the cool areas, or in Canton and Hong Kong in the cool season, more temperate types of vegetables are grown.

As to be expected, rainfall in the lowland areas, tends to be less than in the highland areas, where it is influenced by relief, or altitude. The average annual rainfall in the lowland areas ranges from 1,400mm in Bangkok to 2,400mm in Singapore, whereas in the highland areas average annual rainfall ranges from 2,600mm in the Cameron Highlands to 5,000mm in Baguio.

The incidence of typhoons throughout the case study areas is also variable, but is related to latitude. Typhoons are not experienced in the low latitude areas of Singapore and the Cameron Highlands at 1 ^{0} and 5 ^{0} N but they are experienced in the other Southeast Asian areas and also in Canton and Hong Kong. However, the effect of typhoons as such on vegetable farming practices is not thought to be great, although the effect on growing crops actually hit by a typhoon can be disastrous.

When relief and climate are considered together it is possible to identify three distinct types of area, as follows:

(i) Lowland areas with both cool and warm seasons, viz., Canton and Hong kong;

(ii) Lowland areas with warm seasons or warm weather only, viz., Bangkok, Singapore, Manila and Cebu;

(iii) Highland areas with cool seasons or cool weather only, viz., Cameron Highlands and Bagiuo.

In terms of soils it is difficult to distinguish between the different areas. Medium textured loam soils tend to predominate in all the case study areas apart from the Bangkok area, which has heavy textured clay soils only. However, some heavy textured clay soils also occur in the Singapore, Cameron Highlands and Manila areas. In addition, in the Hong Kong, Singapore and Cameron Highlands areas some light textured sandy soils also occur. Hence, it is difficult to identify distinct types of area in terms of soil texture and probably not worthwhile attempting to do so.

Human Environments

In Table 7.2, the human environments of the different case study areas are compared, in terms of markets, farming structure, farm labour supply and farm input supply.

Large urban centres constitute the main markets for all of the areas. The lowland areas are located relatively near to their large urban markets, i.e., within 50 km, whereas the highland areas are located relatively far from their large urban markets, i.e., more than 200 km.

Table 7.2 Comparison of the human environments of case study areas.

		Canton	Hong Kong	Bangkok	Singapore	Cameron Highlands	Manila	Cebu	Baguio
Markets Size									
Large urban centres		●	●	●	●	●	●	●	●
Small urban centres									
Proximity	Near (0-50km)	●	●	●	●		●	●	O
	Far (200km+)	O				●			●
Access	Road	●	●	●	●	●	●	●	●
	Canal			O					
Channels	Commercial		O	●	●	●	●	●	●
	Governmental	●	O						
Farming structure									
Farm Size	Small (0-4ha)		●	●	●	●	●	●	●
	Large (40ha+)	●							
Livestock	Few on farms		●	●	●	●	●	●	●
	Many on farms	●	O		O				
Tenure	Farms rented	*	●	●	●	-	●	O	O
	Farms owned	*	O	O		-	O	O	O
Farm labour supply									
Type	Family	*	●	●	●	-			O
	Hired	*		O		-	●	●	O
Race	Chinese	●	●	O	●	●		O	O
	Non-Chinese			O		O	●	O	O
Farm input supply									
Organic fertilizer	Farm origin	O	O	●	●	●	●	●	●
	Non-farm "	O	●		O		O	O	
Chemicals & machines	From dealers		O	●	●	●	●	●	●
	From gov'mnt	●	O						
Seed	Bought from dealers		O	●	●	-	●	●	●
	Saved on farms	●	●						
Water	Surface water	●	O	●	O	●			O
	Ground water	O	O		O		●	●	O

Source: Chapters 2 and 3.
Note: Key: ● = All or most parts of case study area
O = Some parts of case study area
* = Not applicable, collective farms
- = No data.

The only two minor exceptions to this are that the Canton area also provides some vegetables for the distant Hong Kong market and the Baguio area also provides some vegetables to the local Baguio City market, but in neither of these cases are the proportions of vegetables sold in the subsidiary market that great. In all of the areas trucks, or similar vehicles, are used for transportation of produce to markets, although in Bangkok boats are also used. However, a marked difference exists in marketing channels between Canton and the Southeast Asian areas. Canton's present marketing channel is through the local government authorities, whereas the marketing channels of the Southeast Asian areas are commercial; Hong Kong's present marketing channel is partly governmental and partly commercial. In the past though, before the communist takeover, the marketing channels in Canton were also commercial. Hence the marketing aspects of the human environments of the case study areas are basically similar, except for the factor of proximity, to market, which is different for the lowland and highland areas. The significance of this factor of proximity, or conversely of distance, lies in its effect on the type of vegetable crops grown in the different areas. In the lowland areas near to markets more perishable leafy vegetables are grown, whereas in the highland areas distant from markets a greater proportion of less perishable fruit and root vegetables are grown.

In terms of markets, then, it is possible to identify two distinct types of area, as follows:

(i) Areas near to markets (lowland areas), viz., Canton, Hong Kong, Bangkok, Singapore, Manila and Cebu;

(ii) Areas far from markets (highland areas) viz., Cameron Highlands and Baguio.

In terms of farming structure it is possible to distinguish to some extent between the different case study areas. Farm size in Canton is large, i.e., more than 40ha, and reflects the present collective farm organization introduced since the communist takeover. Farm sizes in Hong Kong and all the Southeast Asian areas are small, i.e., less than 4 ha. Many livestock are kept on the farms in Canton, whereas few are kept on the farms in Hong Kong and all the Southeast Asian areas, except for two farms in Hong Kong and one farm in Singapore. Concerning land tenure, land is collectively farmed in Canton, whereas it is mostly rented in Hong Kong and in the Southeast Asian areas. Farm access is by road in all of the areas, although in Bangkok canal access is also important. Hence, in terms of farming structure, the areas in Hong Kong and Southeast Asia are essentially similar. The present differences between these areas and Canton in farm size and land tenure, have been brought about largely through the collectivization of small farms in Canton since the communist takeover. Discounting these differences for the reason that they are only of very recent origin, the farming structures of all the areas then appear to be basically similar, so that it becomes difficult to distinguish between the different areas, except for the fact that the number of livestock kept in the Canton area is higher than in the other areas. This though probably reflects traditional mixed farming practices rather than collectivization. Of course, the farms in Canton are much larger than those in the other areas so that higher livestock numbers on these farms are not necessarily significant. Hence, it is probably not worthwhile attempting to distinguish between the different areas in terms of livestock numbers.

The type of farm labour used varies considerably between the different case study areas. Family labour is the main type of labour used in Hong Kong, Bangkok and Singapore, whereas hired labour is the main type used in Manila and Cebu. A mixture of family and hired labour is used in Baguio. In Canton, though, farm labour is organized collectively. The race of farmers and farm labourers also varies between the different case study areas. In Canton, Hong Kong and Singapore all are Chinese; in Bangkok, Cameron Highlands, Cebu and Baguio there is a mixture of Chinese and non-Chinese, i.e., indigenous; and in Manila all are indigenous. Because of the mixture in most of the Southeast Asian areas it is difficult to distinguish between them and probably not worthwhile attempting to identify different types of area in terms of race of farmers and farm labourers. However, the important point to bear in mind regarding race of farmers and farm labourers in Southeast Asia is that **traditional Chinese vegetable farming practices are used in areas with indigenous Southeast Asian farmers as well as in areas with immigrant Chinese farmers.**

In terms of farm input supply it is difficult to distinguish between the different case study areas in Southeast Asia, although there are marked differences between these areas and Canton and Hong Kong. Organic fertilizers in the Southeast Asian areas are mainly of farm origin and usually bought from livestock farms, although some organic fertilizers of non-farm origin are also bought, e.g., fish wastes and oil-seed cakes. In Canton a mixture of animal manure of farm origin together with nightsoil and various other wastes of non-farm origin are used, supplied either by the farm itself or by the local government authorities. In Hong Kong most organic fertilizers are of non-farm origin. Agricultural chemicals and machines in the Southeast Asian areas are bought from commercial dealers, whereas in Canton they are supplied through the local government authorities and in Hong Kong through dealers and government-controlled cooperatives. Similarly, in the Southeast Asian areas seeds are mainly bought from dealers, whereas in marked contrast, in Canton and Hong Kong most of the seed used is saved on the farms themselves from previous crops. Water supply for irrigation, though, varies considerably between all of the different case study areas. Both surface and groundwater water are used in Canton, Hong Kong, Singapore and Baguio. Surface water is used in Bangkok and Cameron Highlands and ground water is used in Manila and Cebu. Because of this high degree of variation between the areas it is also difficult to distinguish between them in terms of water supply and probably not worthwhile attempting to do so.

Vegetable farming environments

From the above comparisons of the environments, both physical and human, of the case study areas, it is possible to identify 5 distinct and widely different types of vegetable farming environment, of which 2 are in South China and 3 are in Southeast Asia, as follows:

(i) Lowland areas, near to markets, with cool and warm seasons, with poor natural drainage, viz., Canton (part) and Hong Kong (part);

(ii) Lowland areas, near to markets, with cool and warm seasons, with good natural drainage, viz., Canton (part) and Hong Kong (part);

(iii) Lowland areas, near to markets, with warm seasons only, with poor natural drainage, viz., Bangkok;

(iv) Lowland areas, near to markets, with warm seasons only, with good natural drainage, viz., Singapore,Manila and Cebu;

(v) Highland areas, far from markets, with cool seasons only, with good natural drainage, viz., Cameron Highlands and Baguio.

In order to summarize the similarities and differences that exist between the vegetable farming environments of Southeast Asia and South China, Table 7.3 has been drawn up.

Table 7.3 Comparison of the vegetable farming environments of case study areas: similarities and differences between Southeast Asia and South China.

		South China (2 areas)	Southeast Asia (6 areas)
Physical environment			
Relief	Altitude	Lowland	Lowland and highland
	Slope	Flat to moderate	Flat to steep
Drainage		Poor and good	Poor and good
Climate	Type	Monsoon	Tropical monsoon, equatorial and high-land
	Seasonality	Both warm and cool seasons in same area	Warm seasons only or cool seasons only in same area
Soils	Texture	Medium and light	Heavy to light
Human Environment			
Markets	Proximity	Near and far	Near and far
	Access	Road	Road
	Channels	Governmental & commercial	Commercial
Farming structure	Farm size	Large and small	Small
	Livestock	Many and few	Few
	Tenure	Collective & mostly rented	Mostly rented
Farm labour supply	Type	Production brigade workers and family labour	Family and hired labour
	Race	Chinese	Chinese & Non-Chinese
Farm input supply	Organic fertilizers	City, farms, dealers	Other farms mainly
	Chemicals & machines	Government, coops & dealers	Dealers
	Seed	Mainly saved on farms	Mainly bought from dealers
	Water	Surface and ground	Surface and ground

Source: Tables 7.1 and 7.2.

USE OF TRADITIONAL CHINESE VEGETABLE FARMING PRACTICES IN DIFFERENT TYPES OF ENVIRONMENT IN SOUTHEAST ASIA

Detailed information on the use of traditional Chinese vegetable farming practices in the case study areas in Southeast Asia is presented in Chapters 4-6. This information is summarized in this chapter in Tables 7.4 - 7.6. These tables have been drawn up to facilitate an assessment of the extent to which the traditional Chinese practices are used, or have been used in the recent past, in the different case study areas in Southeast Asia, and hence, to facilitate an assessment of the extent to which the practices are used, or have been used, in the different types of vegetable farming environment in Southeast Asia. The tables and the discussion of them which follows are arranged, for the sake of continuity with previous chapters, in an order of farming operations, as follows: planting and multiple cropping, land preparation, fertilizing, irrigation and drainage, weed control, pest and disease control, and harvesting and packing.

Planting and Multiple Cropping

The continuous sequential planting of relatively short duration crops is found in all of the case study areas, although in Baguio some fallow periods are unavoidable owing to seasonal water shortage. The practice of continuous sequential planting contributes to achieving a high cropping intensity, as shown in Chapter 1.

The practice of transplanting, mainly of leafy vegetables, which also contributes to achieving a high cropping intensity, is widely used in most of the case study areas, although in Bangkok and Singapore the

Table 7.4 Use of traditional Chinese vegetable farming practices in the case study areas in Southeast Asia.

	Bangkok	Singapore	Cameron H'Lands	Manila	Cebu	Baguio
	L,PD	L,GD	H,GD	L,GD	L,GD	H,GD
Planting and multiple cropping						
Continuous sequential planting	●	●	●	●	●	O
Transplanting of leafy vegs	O	O	●	●	●	●
Interplanting	O	X	●	X	O	O
Staggering of planting dates	●	●	+	●	●	-
Diversified cropping	●	●	●	●	●	●
Rotation of crops	●	●	-	●	●	●
Land Preparation						
Terracing of fields	X	X	●	X	X	●
Levelling of fields	●	X	●	X	X	●
Bunding of fields	●	X	O	X	X	●
Low raised beds, with footpaths between	X	●	●	●	●	●
High raised beds,with ditches between	●	X	X	X	X	X
Hoe cultivation	●	●	●	●	●	●
Ploughing with animals	X	X	X	O	●	X
Mulching of seed beds	●	O	-	●	●	●
Mulching of field beds	●	O	-	X	X	O
Overhead protection of seed beds	O	+	-	X	X	O
Trellising of climbing fruit vegetables	*	O	●	*	X	●
Use of clay pots for blanching chives	+	X	X	X	X	X

Table 7.4 (continued) Use of traditional Chinese vegetable farming practices in the case study areas in Southeast Asia.

	Bangkok	Singapore	Cameron H'Lands	Manila	Cebu	Baguio
	L,PD	L,GD	H,GD	L,GD	L,GD	H,GD
Fertilizing						
Frequent use of organic fertilizers	●	●	●	●	●	●
Liming	O	O	-	-	X	+
Irrigation and Drainage						
Frequent watering in dry weather	●	●	-	●	●	●
Ditch and scoop irrigation	●	X	X	X	X	X
Sump and bucket irrigation	X	+	X	●	●	●
Drainage by ditches between beds	●	X	X	X	X	X
Drainage by footpaths between beds	X	●	●	●	●	●
Water lifting by dragon bone pump	●	X	X	X	X	X
Weed Control						
Pre-planting cultivations	●	●	●	●	●	●
Mulching of field beds	●	O	-	X	X	O
Multiple cropping	●	●	●	●	●	O
Handpulling or hoeing	●	●	●	●	●	●
Pest and disease control						
Building up soil fertility, to enhance crop vigour	●	●	●	●	●	●
Removing weeds and crop residues	●	●	●	●	●	●
Rotation of crops	●	●	-	●	●	●
Interplanting	O	X	●	X	O	O
Use of organic pesticides	-	+	-	-	-	-

Table 7.4 (continued) Use of traditional Chinese vegetable farming practices in the case study areas in Southeast Asia.

	Bangkok	Singapore	Cameron H'Lands	Manila	Cebu	Baguio
	L,PD	L,GD	H,GD	L,GD	L,GD	H,GD
<u>Harvesting and packing</u>						
Continuous harvesting by hand	●	●	●	●	●	●
Use of bamboo baskets	●	●	●	O	●	●

Source: Chapters 4-6.

Note: Key:

● = Widely used at present

O = Occasionally used at present

+ = Not observed by present writer, but reported by previous writers

* = Not applicable, as trellis crops not grown

X = Not used, i.e., no instances of use observed or reported

- = No data

L = Lowland

H = Highland

PD = Poor drainage

GD = Good drainage.

Table 7.5 Use of mulching materials in the case study areas in Southeast Asia.

	Bangkok	Singapore	Cameron H'Lands	Manila	Cebu	Baguio
	L,PD	L;GD	H,GD	L,GD	L,GD	H,GD
Rice straw	●	X	-	●	●	X
Cogon grass	X	X	-	X	X	●
Woodshavings	X	O	-	X	X	X
Matting and old cloth	X	X	-	X	X	O

Source: Chapters 4 - 6.

Note : Key: ● = Widely used at present

O = Occasionally used at present

X = Not used, i.e., no instances of use observed or reported

- = No data

L = Lowland

H = Highland

PD = Poor drainage

GD = Good drainage.

Table 7.6 Use of organic fertilizer materials in the case study areas in Southeast Asia.

	Bangkok	Singapore	Cameron H'Lands	Manila	Cebu	Baguio
	L,PD	L,GD	H,GD	L,GD	L,GD	H,GD
Nightsoil	+	+	+	X	X	X
Pig Manure	+	+	X	X	X	X
Cattle manure	X	X	X	X	X	O
Chicken manure	O	●	●	●	●	●
Duck manure	●	X	X	X	X	X
Fish waste	X	X	+	X	X	X
Prawn dust	X	+	O	X	X	X
Soya bean cake	X	+	+	X	X	X
Kapok seed cake	X	X	X	+	O	X
Lumbang seed cake	X	X	X	●	X	X
Weeds	X	X	X	X	X	O
Burnt earth	X	+	X	X	X	X

Source: Chapters 4-6.

Note: Key:

● = Widely used at present

O = Occasionally used at present

+ = Not observed by present writer, but reported by previous writers

X = Not used, i.e., no instances of use observed or reported

L = Lowland

H = Highland

PD = Poor drainage

GD = Good drainage.

practice of direct sowing is now more commonly used. In Singapore, though, transplanting of leafy vegetable crops was more common in the past. The change is probably related to a decreasing availability, or an increasing cost, of farm labour in Singapore in recent years, a factor which would encourage the practice of direct sowing with its lower labour requirements.

Interplanting, which also contributes to achieving a high cropping intensity, is a practice used in most of the case study areas, although not widely so. In Singapore and Manila though interplanting is not practised at all.

The practices of staggering of planting dates and diversified cropping are widely used throughout the case study areas. Similarly, the practice of crop rotation is also widely used.

Hence it can be seen that the planting and multiple cropping practices used in South China are, in the main, widely used in the Southeast Asian case study areas, with the exception of interplanting which is only occasionally used. No marked differences are apparent in the use of planting and multiple cropping practices in the different types of vegetable farming environment identified in the first part of this chapter; all the practices are used in the three different types of vegetable farming environment.

Land Preparation

Although not used in Canton, the practice of terracing fields is used in the Cameron Highlands and Baguio, both of which are highland areas. Terracing is required on the steeply sloping land in these areas to control runoff and prevent soil erosion. None of the other case study areas have terraced fields.

Levelling and bunding of fields is carried out not only in the highland areas but also in Bangkok, a lowland poorly drained area which is similar to much of the Canton area. The fields in the highland areas are levelled and bunded in order to control runoff and prevent soil erosion. The fields of the lowland poorly drained areas are levelled and bunded in order to facilitate irrigation and also, in the case of bunding, to prevent flooding from neighbouring areas. Of course, the field bunds used for flood prevention are much larger and higher than the field bunds used to control runoff. Levelling and bunding of fields is not carried out in any of the lowland areas with good drainage, viz., Singapore, Manila or Cebu.

The practice of constructing raised beds is used universally in all the case study areas. Apart from the few instances where aquatic crops, e.g., watercress, are grown in flooded basins, all vegetable crops are grown on raised beds. However, two different kinds of raised bed can be distinguished in the case study areas. In Singapore, Cameron Highlands, Manila, Cebu and Baguio, which are all areas with good drainage, relatively low raised beds with footpaths between them are constructed. In Bangkok, an area with poor drainage, high raised beds with ditches between them are constructed. The low raised beds with footpaths between them provide adequate field drainage in areas not prone to flooding; the footpaths also provide access to crops. The high raised beds with deep ditches between them are required to prevent the flooding of crops in poorly drained low-lying areas; the ditches also provide access to crops and a source of water for irrigation in dry weather.

Hoe cultivation is also universally carried out in all of the case study areas. However, ploughing with animals, although common in Canton, is not carried out in the Southeast Asian case study areas except in Cebu and occasionally in Manila.

The practice of mulching seed beds is widely used in the case study areas, but the practice of mulching field beds is much less used, viz., not at all in Manila and Cebu, occasionally in Singapore and Baguio, although fairly often in Bangkok. The kinds of mulching materials used in the case study areas are shown in Table 7.5.

The practice of providing overhead protection for seed beds is occasionally used in Bangkok, with palm fronds, and in Baguio, with permanent structures similar to open-sided greenhouses. Palm fronds were also used in the past in Singapore. However, in Manila and Cebu the practice is not used.

In those case study areas where climbing fruit vegetables, e.g., beans and gourds, are grown, mainly in the Cameron Highlands and Baguio, they are almost always grown on trellises, the only exception being found in Cebu. However in general in the case study areas in Southeast Asia climbing fruit vegetables are grown far less frequently than they are in Canton.

The practice of using clay pots for blanching Chinese chives is not used in the Southeast Asian case study areas except in Bangkok.

Fertilizing

The practice of using organic fertilizers, applied frequently and in large amounts, is universally used in all of the case study areas. A great variety of organic materials is used, as is shown in Table 7.6. However, it is notable that although nightsoil has been used in the past in Bangkok, Singapore and the Cameron Highlands, it is no longer used in these areas because of restrictions. Pig manure was also used in Bangkok and Singapore but is now no longer used. Cattle manure is not used, except occasionally in the Baguio area. Poultry manure, though, is widely used in all of the case study areas, particularly chicken manure, although duck manure is more important in Bangkok. Other organic materials which are presently used or have been used in the past include fish waste, prawn dust, various types of oil-seed cake, as well as composted weeds and burnt earth. Urban domestic rubbish is not used. It is apparent that the farmers choose the kind of material to use according to the local availability of that material. Within reason, it does not appear to matter what kind of material is used. Liming of soils in the Southeast Asian case study areas is only occasionally practised.

Irrigation and Drainage

The practice of frequent watering of crops in dry weather, often several times per day, is universally carried out in all the case study areas, with the possible exception of the Cameron Highlands where more regular rainfall reduces the requirement for frequent irrigation. The methods of water application used vary in the different case study areas according to the particular type of vegetable farming environment. In Bangkok, a lowland area with poor drainage, the ditch and scoop method is used. In Singapore, Manila and Cebu, which are lowland areas with good drainage, the sump and bucket method is used, or in the case of Singapore it was used in the past. The sump and bucket method is also the principal method used in the Baguio area. Otherwise, in the highland areas, in the Cameron Highlands and to some extent in the Baguio area, furrow irrigation is used, by inundating the footpaths between the raised beds. Where aquatic crops are grown the basin method is used, but the only instance of this is the Cameron Highlands watercress fields.

The methods of drainage used also vary in the different case study areas according to the type of vegetable farming environments. In the lowland poorly drained area of Bangkok, the ditches between the high raised beds serve as field drains. In all the other Southeast Asian case study areas, which have good drainage, the footpaths between the low raised beds serve as field drains.

The practice of water lifting with dragon bone pumps is used in the Bangkok area, which is similar to the lowland, poorly drained part of the Canton area. The dragon bone pumps are used mainly for drainage, viz., lifting excess water from the field ditches into the main canals, but are sometimes also used for supplying irrigation water to the fields from the canals. However, they are not used in any of the other Southeast Asian case study areas.

Weed Control

The practice of pre-planting cultivations, which destroys weeds before the crops are planted, is used universally in all of the case study areas. However, the practice of mulching field beds, which suppresses weed growth during crop growth, is not widely used, except in Bangkok. It is though occasionally used in Singapore and Baguio. Multiple cropping, which also suppresses weed growth, through the maintenance of a crop cover whenever possible, is widely practised throughout the case study areas. Weeds that do grow during crop growth are destroyed or removed in all areas by hoeing or hand pulling of weeds. It is characteristic of all the case study areas that the crop beds are clean-weeded. Weed infested crops are very rarely seen.

Pest and Disease Control

Arguably, one of the most important practices, which effects a certain degree of control over the impact of crop pests and diseases is the building up of soil fertility through the frequent application of large amounts of organic fertilizers. The build-up of soil fertility in turn builds up the general vigour of crop plants and their ability to overcome any damage caused by pest and disease organisms. This view, with particular reference to virus diseases, is supported by Williams (1981: 136). The practice of building up soil fertility, and hence crop vigour, through organic fertilizing, is used universally in all the case study areas.

The removal of weeds and crop residues before planting also exerts a measure of control over crop pest and disease organisms, because both weeds and crop residues can harbour pest and disease organisms between the harvest of one crop and the planting of another. This practice is also used universally in the case study areas.

The rotation of crops is another universally used means of achieving control over crop pests and diseases, through the breaking of otherwise continuous pest and disease organism life cycles, since different crops are not hosts to the same pest and disease organisms.

The practice of interplanting, although not widely used in the case study areas, also helps to a limited extent to reduce the local spread of certain pest and disease organisms through the provision of a row or barrier of non-susceptible plants between other rows of susceptible plants.

Apart from these generally preventative practices, the practice of applying organic, naturally occurring, pesticides has been used in the past in Singapore as in Canton. The two compounds nicotine, derived from tobacco plants, and derris, derived from derris plants, were used in the past as organic pesticides, but today are no longer used.

Harvesting and Packing

The practice of harvesting, by hand, on a continuous, often daily, basis is used universally in all the case study areas. The practice of packing vegetables in bamboo baskets is also used universally.

CONCLUSION

From Tables 7.4-7.6 and the discussion which follows them, it is possible to assess the extent to which the traditional vegetable farming practices of Canton are used, or have been used in the recent past, in the different types of vegetable farming environment. Such an assessment is made in Table 7.7., in terms of which practices are used in all the different types of environment and which are used in only some types of environment. Table 7.7 shows that most of the practices are used in all the types of environment; many of them are widely used in all the types of environment. It is notable, too, that none of the traditional practices identified in the case study of Canton are not used, or have never been used, in any of the different types of vegetable farming environment. To clarify where the practices used in only some types of environment are in fact used, Table 7.8 has been drawn up. From these tables, it can be seen that **traditional Chinese vegetable farming practices in general have already been successfully used in a number of widely different environments in Southeast Asia in the recent past;** and most of them are still being successfully used today.

Table 7.7 The extent of use of traditional Chinese vegetable farming practices in the different types of vegetable farming environment.

Farming Operation	Practices used in all types of environment	Practices used in only some types of environment
Planting and multiple cropping	Continuous sequential planting* Transplanting leafy veg Interplanting Staggering of planting dates Diversified cropping* Rotation of crops*	
Land preparation	Raised beds* (type varies with environment) Hoe cultivation* Mulching of seeds beds*, and occasionally of field beds Overhead protection of seed beds Trellising of climbing veg.	Terracing, levelling & bunding of fields Ploughing with animals Use of clay pots for blanching chives
Fertilizing	Frequent use of organic fertilizers* Liming	
Irrigation and drainage	Frequent watering in dry weather * (various methods of irrigation) Drainage between raised beds* (by ditch or footpath)	Water lifting dragon bone pumps
Weed control	Pre-planting cultivations* Mulching of field beds Multiple cropping* Hand pulling or hoeing*	
Pest & disease control	Building up soil fertility* Removing weeds & crop residues* Rotation of crops* Interplanting	Use of organic pesticides
Harvesting & packing	Continuous harvesting by hand* Use of bamboo baskets*	

Note: Key: * = Practice is widely used in all types of environment.

Table 7.8 The use of traditional Chinese vegetable farming practices in Southeast Asia, according to type of vegetable farming environment.

<table>
<tr><th>Farming Operation</th><th>Lowland areas, poorly drained</th><th>Lowland areas, well drained</th><th>Highland areas, well drained</th></tr>
<tr><td>Planting and multiple cropping</td><td colspan="3">Continuous sequential planting
Transplanting of leafy vegetables
Interplanting
Staggering of planting dates
Diversified cropping
Rotation of crops</td></tr>
<tr><td>Land preparation</td><td>Levelling and bunding of fields
High raised beds, with ditches between</td><td>Low raised beds with footpaths between</td><td>Terracing, levelling and bunding of fields
Low raised beds, with footpaths between</td></tr>
<tr><td></td><td colspan="3">Hoe cultivation, and occasionally ploughing with animals
Mulching of seed beds, and occasionally of field beds
Overhead protection of seed beds
Trellising of climbing fruit vegetables</td></tr>
<tr><td></td><td>Use of clay pots for blanching chives</td><td></td><td></td></tr>
<tr><td>Fertilizing</td><td colspan="3">Frequent use of organic fertilizers, including human and animal manure, fish wastes and, oil-seed cake
Liming</td></tr>
<tr><td>Irrigation and drainage</td><td colspan="3">Frequent watering of crops in dry weather, several times per day</td></tr>
<tr><td></td><td>Ditch and scoop irrigation</td><td>Sump and bucket irrigation</td><td>Sump and bucket, irrigation</td></tr>
<tr><td></td><td>Drainage by ditches between beds
Water lifting with dragon bone pumps</td><td>Drainage by footpaths between beds</td><td>Drainage by footpaths between beds</td></tr>
<tr><td>Weed control</td><td colspan="3">Pre-planting cultivations
Mulching of field beds
Multiple croppping
Hand pulling or hoeing</td></tr>
<tr><td>Pest and disease control</td><td colspan="3">Building up soil fertility, to enhance crop vigour
Removing weeds and crop residues
Rotation of crops
Interplanting
Use of organic pesticides</td></tr>
<tr><td>Harvesting and packing</td><td colspan="3">Continuous harvesting by hand
Use of bamboo baskets</td></tr>
</table>

CHAPTER 8

THE USE OF MODERN WESTERN VEGETABLE FARMING PRACTICES IN THE CASE STUDY AREAS

INTRODUCTION

It was shown in Chapter 1 that the use of traditional Chinese vegetable farming practices in South China was characterized by :

(i) high productivity of land
(ii) negligible use of fossil fuel energy
(iii) negligible pollution of the environment and
(iv) high use of labour.

It was further shown, in Chapter 7, that traditional Chinese vegetable farming practices have already been successfully used in a number of widely different vegetable farming environments in Southeast Asia in the recent past. However, it is very apparent in all of the case studies, that the current vegetable farming practices are not purely traditional in character. They are, in fact, a mixture of traditional Chinese and modern Western practices, and to some extent the modern Western practices have replaced the traditional Chinese practices. Hence some account needs to be given of the current use of modern Western practices and their significance in the case study areas. The aim of this chapter is to provide such an account.

In considering the use of modern Western practices in the case study areas, three questions arise:

(a) To what extent are they currently used in each area?

(b) Why have they been introduced?

(c) What effect has their use had on productivity of land, use of fossil fuel energy, pollution of the environment and use of labour?

Perhaps a more fundamental question underlies these three stated questions: Does the introduction of modern Western practices represent some **improvement** over the use of traditional Chinese practices? In attempting to answer this question, it needs to be realized that the introduction of machinery and chemicals, which make up the modern Western practices, more or less inevitably leads to increased fossil fuel energy use and environmental pollution, and to decreased labour use. Hence, the only real scope for improvement lies in increasing the productivity of land upwards from an already high level.

Therefore, possibly the most important question to ask about the introduction of modern Western practices, in the context of the present study, is as follows. Does the use of modern Western practices result in an increase in the productivity of land, over and above that obtained with the use of traditional Chinese practices? If it can be shown that it does not do so, then it could be concluded that the introduction of modern Western practices does not represent an improvement. If such a conclusion were drawn, perhaps the only case that could then be made for introducing modern Western practices would be the possible increase in economic profitability enjoyed by the farmer.

EXTENT OF CURRENT USE OF MODERN WESTERN PRACTICES

In the different case study areas, the extent of current use of modern Western practices varies. An analysis of the extent of current use of these practices, in each of the case study areas, is set out in Table

8.1. (The Cameron Highlands area has been omitted, as sufficient data are not available). The analysis is based on data collected during the course of the writer's fieldwork in 1981. It is not based on data presented by previous writers, since such data no longer represent the current use of modern Western practices, except for that presented by Suijkerbuijk (1982). Table 8.1 is divided into two main parts: mechanization and chemicalization.

Mechanization

In making an assessment of the extent of mechanization in the different case study areas, two criteria have been used, namely, the percentage of farms on which mechanical cultivators are used (item 3) and the percentage of farms which have motorized irrigation and/or drainage pumps (item 4). These are the two major forms of mechanization on the farms, apart from small biocide (pesticide) sprayers, which are used on all farms, and sprinkler irrigation equipment, which has been installed on just a very few farms in Canton, Hong Kong and Singapore. Mechanized transportation of produce to markets is not included in the criteria, because it is not a farming practice as such.

By adding together the percentages of farms with mechanical cultivators and motorized irrigation pumps (items 3 and 4), in each sample of farms, a mechanization rating (item 5) has been calculated for each case study area. To each of the mechanization ratings a relative value of low, moderate (mod) or high has been assigned (item 6). These values indicate the relative level, or relative extent, of mechanization in each of the case study areas. It needs to be stressed that these relative levels are in no way absolute levels. They are only intended to be a means of comparing the sample farms in the different case study areas.

Table 8.1 Current use of modern Western farming practices on sample farms in case study areas.

Item	Canton	Hong Kong	Bangkok	Singapore	Manila	Cebu	Baguio
1 Sample size, no of farms	3	7	4	7	3	2	4
2 Farm size, average, ha	105	0.4	1.5	1.2	1.4	1.4	2.5
Mechanization							
3 % of farms with mechanical cultivators	0	86	0	100	33	0	0
4 % of farms with motorized irrigation/drainage pumps	100	57	100	100	33	0	25
5 Mechanization rating (3+4)	100	143	100	200	66	0	25
6 Mechanization level, relative	Mod	High	Mod	High	Low	Low	Low
Chemicalization							
7 Chemical fertilizer application rate							
a) t/ha/crop, av.	0.1	0.8	1.4	0.6	0.0	0.2	0.6
b) t/ha/year, av.	1.0	5.7	5.3	4.7	0.0	2.3	1.9
8 Chemical fertilizer use level, relative	Low	High	High	High	Low	Mod	Mod
9 % of farms with chemical herbicide use	33	57	0	86	0	0	0
10 % of farms with chemical insecticide use	100	100	100	100	100	100	100
11 Chemical biocide use rating (9+10)	133	157	100	186	100	100	100
12 Chemical biocide use level, relative	Mod	High	Low	High	Low	Low	Low
13 Chemicalization level, relative (8+12)	Low/Mod	High	Mod	High	Low	Low/Mod	Low/Mod

Source: Fieldwork, 1981.

On this basis, Table 8.1 shows that the relative level of mechanization is low in Manila, Cebu and Baguio, moderate in Canton and Bangkok and high in Hong Kong and Singapore.

Chemicalization

In making an assessment of the extent of chemicalization in the different case study areas, two criteria have been used, namely, the actual use of chemical fertilizers in terms of average application rates (item 7) and the percentage of farms with chemical herbicide and chemical insecticide use (items 9 and 10), i.e., chemical biocide use (item 11). These are the two major forms of chemicalization on the farms, apart from some very limited use of chemical fungicides, on which sufficient data for this assessment are not available.

Regarding the use of chemical fertilizers a relative value of low, moderate or high has been assigned (item 8) to the average application rates to indicate the relative level, or extent of chemical fertilizer use in each of the case study areas. On this basis, Table 8.1 shows that the relative level of chemical fertilizer use is low in Canton and Manila, moderate in Cebu and Baguio and high in Hong Kong, Bangkok and Singapore.

Regarding the use of chemical biocides, the percentages of farms with herbicide use and insecticide use (items 9 and 10) have been added together to give a biocide use rating (item 11). To this chemical biocide use rating a relative value of low, moderate or high has been assigned (item12) to indicate the relative level, or extent, of chemical biocide use. On this basis, Table 8.1 shows that the relative level of chemical biocide use is low in Bangkok, Manila, Cebu and Baguio, moderate in Canton and high in Hong Kong and Singapore.

An overall relative level of chemicalization (item 13) has been derived by averaging the relative levels of chemical fertilizer use and chemical biocide use. On this basis, Table 8.1 shows that the relative level of chemicalization is low in Manila, low to moderate in Canton, Cebu and Baguio, moderate in Bangkok and high in Hong kong and Singapore.

REASONS UNDERLYING INTRODUCTION OF MODERN WESTERN PRACTICES

There are two major fundamental reasons underlying the introduction of modern Western practices into vegetable farming in the case study areas. These may be summarized as follows:

(a) A relatively high cost, or low availability, of farm labour in relation to a relatively low cost of fossil fuel energy based farm inputs. This of course can be seen most clearly in areas where levels of mechanization and chemicalization are highest, e.g., in Hong Kong and Singapore. In these areas, alternative industrial job opportunities exist for farm labour and an economic need exists to use labour saving techniques on the farms. Conversely, where hired farm labour is readily available at relatively low cost, e.g., in Manila and Cebu, the levels of mechanization and chemicalization are much lower.

(b) Deliberate government policy to follow the conventional agricultural development strategy of modernizing farming practices. This can perhaps be seen most clearly in Canton. In this area, farm labour is readily available at low cost, but many motorized irrigation pumps and even some sprinkler irrigation systems have been installed on the farms. In other case study areas, government agricultural extension staff often promote the use of modern Western practices.

EFFECTS OF USE OF MODERN WESTERN PRACTICES

Productivity of land

In assessing the effects of the use of modern Western practices on the productivity of land, it is necessary first of all to calculate the actual production levels of the crops grown in the case study areas. Table 8.2 is an attempt to do this. In Table 8.2 the average yields of the 7 most commonly grown vegetable crops have been calculated for each case study area. It should just be mentioned in passing that the 7 most commonly grown vegetable crops throughout the case study areas are in fact leafy vegetables. Fruit and root vegetables are grown much less commonly.

In Table 8.2, two sources of data have been used, firstly, data from the writer's fieldwork and, secondly, data presented by previous writers. The reason for including data presented by previous writers is simply to confirm, or otherwise, that data from the writer's own fieldwork are more or less reliable or reasonably accurate.

Table 8.2 shows that, within the bounds of a limited survey, average yields of leafy vegetables crops do not vary very much between different case study areas, except in one or two instances. In Bangkok, the writer's fieldwork yield figure appears to be rather high, compared to other figures, and previous literature does indicate a lower figure. Similarly, in Baguio, the writer's figure also appears a little high. In both cases, the reason may be due to small samples accentuating possible errors, or, it could be due to some other factors. In Baguio, a highland area, the high crop yield of lettuce may be due to a particularly favourable climatic environment for lettuce. The only other relatively high figure is that of a

Table 8.2 Average yields of leafy vegetable crops in case study areas.

Vegetable crop yield, t/ha/crop (a)	Canton 1	Hong Kong 1	Hong kong 2	Hong Kong 3	Bangkok 1	Bangkok 4	Singapore 1	Singapore 5	Cebu 1	Baguio 1	Average
Flowering white cabbage	10.4	12.5	12.0	18.9	-	-	16.1	18.3	13.3	-	14.5
Chinese white cabbage	7.5	18.0	18.5	16.7	25.2	12.5	-	-	19.6	13.3	16.4
Chinese kale	18.8	17.4	21.2	22.5	21.6	15.9	15.1	12.4	-	-	18.1
Leaf mustard (b)	22.5	11.3	11.3	23.4	26.6	25.0	-	-	20.6	-	20.1
Chinese spinach	15.0	11.7	9.0	-	-	-	21.9	19.3	15.0	-	15.3
Lettuce	18.8	23.8	21.0	19.8	-	15.0	15.0	12.5	11.7	27.9	18.8
Water spinach (dry bed)	18.8	9.0	-	-	-	7.5	19.1	16.0	19.1	-	16.4
Average yield, t/ha/crop	16.0	14.8	15.5	20.3	24.5	15.2	17.5	15.7	16.6	20.6	17.1
say	16	15	16	20	25	15	18	16	17	21	17
Crops grown per year, ave. number	9.7	8.2	-	8.0	4.4	4.4	7.4	7.5	9.5	2.8	6.9
Annual yield t/ha/year (theoretical) (c)	155	121	-	162	108	67	130	118	158	58	118

Sources: 1. Fieldwork, 1981.

2. Hong Kong Agriculture Fisheries Department (1982).

3. Ng (1965: 98,110).

4. Sritunya (1975: 19,37-69)

5. Suijkerbuijk (1982: 21,40).

Notes: (a) The crops listed are the 7 most commonly grown vegetable crops in the case study areas.

(b) Leaf mustard yields for Bangkok, from both sources, are for Swatow mustard.

(c) Theoretical annual yield is the product of average yield multiplied by average number of crops grown per year.

previous study in Hong Kong. However, despite these minor exceptions, the main point that emerges from Table 8.2 is that the average yields of the 7 most commonly grown vegetable crops in the different case study areas are remarkably similar. Particularly notable is the similarity in yields between Canton and Hong Kong and also, between Canton, Singapore and Cebu, together with Bangkok if previous literature only is considered. An average yield level for the 7 most commonly grown leafy vegetable crops, considered together, in all the case study areas is 17 t/ha/crop.

By multiplying the average crop yield figure by the average number of crops grown per year, an annual crop yield figure may be derived for each case study area. However, such figures are essentially theoretical, because individual farmers may not actually grow the 7 most commonly grown vegetable crops in any one year. The annual figures, then, are nothing more than the average crop yield of the 7 most commonly grown crops multiplied by the average number of crops grown per year. Nevertheless they do serve as an indicator of crop production levels.

Table 8.2 shows that, like the average crop yields, the annual yields are remarkably similar throughout the case study areas, although the figures for Baguio and Bangkok do appear to be somewhat low. In both of these cases, this is due to a relatively low number of crops grown per year, especially in the Baguio area. The annual yield levels of Canton, Hong Kong, Singapore and Cebu are remarkably similar.

An average theoretical annual yield for the 7 most commonly grown leafy vegetable crops in all the case study areas is 118 t/ha/year. The equivalent annual yield figure is about 140 t/ha/year if the Baguio and Bangkok cases are excluded; this figure, then, relates to

Canton, Hong Kong, Singapore and Cebu only. Some supporting evidence for such an annual yield comes from previous literature, namely, a study of Singapore in the early 1950's by Blaut (1953: 45). He calculated that the annual yield for one particular farm, more or less specializing in leafy vegetable production, was about 148 t/ha/year. It is interesting to note that this yield figure was obtained at a time when the practices used were almost purely traditional Chinese.

The important, indeed critical, conclusion to be drawn from the data presented in Table 8.2 is that the levels of vegetable crop production, measured in terms of average crop yields and average annual yields, in the different case study areas are remarkably similar, i.e., they do not vary very much in the different areas. On the other hand, from the data presented in Table 8.1 it can be seen that levels of mechanization and chemicalization vary considerably in the different case study areas. Thus it can reasonably be maintained that **increases in the level of mechanization and chemicalization, i.e., in the use of modern Western practices, have not significantly increased levels of crop production.** Perhaps the clearest example of this is shown in the cases of Canton and Hong Kong, which are areas with very similar physical environments. In Hong Kong, with a high level of mechanization and chemicalization, levels of crop production are very similar to those of Canton, with a considerably lower level of mechanization and chemicalization. A similar picture emerges in the cases of Cebu and Singapore. Table 8.3 has been drawn up to show these examples more clearly.

Use of fossil fuel energy

The general relationship that exists between the use of fossil fuel energy and the mechanization and chemicalization of agriculture has

Table 8.3 Effects of mechanization and chemicalization on productivity of land, fossil fuel energy use, environmental pollution and labour use.

	Canton	Hong Kong	Bangkok	Singapore	Manila	Cebu	Baguio
Mechanization level, relative	Mod	High	Mod	High	Low	Low	Low
Chemicalization level, relative	Low/ Mod	High	Mod	High	Low	Low/ Mod	Low/ Mod
Productivity of land:							
(a) ave. crop yield,t/ha/crop	16	15	25	18	-	17	21
(b) annual crop yield,t/ha/year	155	121	108	130	-	158	58
Fossil fuel energy use level, relative	Low/ Mod	High	Mod	High	Low	Low/ Mod	Low/ Mod
Environmental pollution risk level, relative	Low/ Mod	High	Mod	High	Low	Low/ Mod	Low/ Mod
Labour Use:							
(a) persons/ha	21.2	4.5	3.0	4.3	8.1	5.2	2.9
(b) persons/ha/crop	2.3	0.6	0.7	0.6	0.8	0.6	1.2

Sources: 1. Fieldwork,1981.

2. Tables 8.1 and 8.2.

been discussed at length in the literature, e.g., by Pimentel (1979). Suffice it is to say, for the purpose of this study, that fossil fuel energy use increases in direct proportion to increases in mechanization and chemicalization, i.e., in direct proportion to the use of modern Western practices. Hence, as shown in Table 8.3, fossil fuel energy use is relatively low (low or low/moderate) in Canton, Manila, Cebu and Baguio, relatively moderate in Bangkok and relatively high in Hong Kong and Singapore. Of course, fossil fuel energy use is negligible where traditional Chinese practices are used without modern Western practices, but such a situation no longer exists in any of the case study areas.

In a quantitative study on the energetics of vegetable production in Hong Kong, Newcombe (1976: 429) showed that the introduction of Western agricultural technology over a 15 year period (late 50's - early 70's) increased the energy costs of Brassica (cabbage) production by 585%, but only increased yields by 8%.

Pollution of the environment

Many instances of pollution of the environment with agricultural chemicals have been described in the literature, e.g., by Dasmann et al (1973: 153-156, 195 and 229). These instances stem mainly from the misuse or excessive use of biocides, in particular insecticides and herbicides, many of which are highly poisonous. However, some instances of pollution have been caused by the excessive application of chemical fertilizers, which enter water courses and lead to nutrient build-up and consequent depletion of dissolved oxygen in the water (a process called eutrophication). Suffice to say, for the purpose of this study, that the risk of pollution of the environment with chemicals increases in direct proportion to increases in chemicalization. Hence, it can be shown in Table 8.3 that the environmental pollution risk is relatively low (low or low/moderate) in Canton, Manila, Cebu and Baguio, relatively moderate in Bangkok and relatively high in Hong Kong and Singapore. Of course, environmental pollution risk is negligible where traditional Chinese practices are used without application of chemicals, but such a situation no longer exists in any of the case study areas.

Use of labour

Data on the average amounts of labour used, in terms of persons/ha and persons/ha/crop, in the different case study areas are also set out in Table 8.3 The table shows that labour use in Canton is very much higher than in any of the other case study areas, even than in those areas with similarly low relative levels of mechanization and chemicalization, viz., Manila, Cebu and Baguio. The reason why labour use in Canton is so much higher is not known, but it may be speculated that it has something to do with the high level of government control of vegetable farming in Canton.

Table 8.3 shows that Manila has the next highest level of labour use; which is to be expected with its relatively low levels of mechanization and chemicalization. However, Table 8.3 also shows that Cebu, with a similarly low level of mechanization and chemicalization, has a labour use level more similar to those of Hong Kong and Singapore, which have relatively high levels of mechanization and chemicalization.

Table 8.3 also shows that Bangkok and Baguio have relatively very low labour use levels in terms of persons/ha, but it has to be remembered that in both of these areas the number of crops grown per year is low.

Hence, their relative labour use levels in terms of persons/ha/crop are somewhat higher than in other areas.

Overall, it is difficult to see a clear relationship regarding the effects of mechanization and chemicalization on the use of labour in the case study areas. There is some evidence to suggest that mechanization and chemicalization decrease labour use, as could be expected. The examples which show this are those of Canton and Manila which have higher labour use levels than Hong Kong and Singapore. However, the relatively low level of labour use in Cebu tends to contradict this expected relationship.

CONCLUSION

Modern Western vegetable farming practices have been introduced to varying extents in the different case study areas. The use of modern Western practices though has not significantly increased the productivity of land. The use of these practices has, however, increased the use of fossil fuel energy and the risk of environmental pollution. There is also some evidence to show that the use of these practices has decreased the use of labour. Hence, the introduction of modern Western practices does not represent an improvement over the use of traditional Chinese practices, in the context of this study. In fact, the introduction of modern Western practices is only leading to the same problems of energy, pollution and unemployment set out in the context of this study in the Introduction.

CONCLUSIONS

It was shown in Chapter 1 that the use of traditional Chinese vegetable farming practices in South China is characterized by (i) high productivity of land (ii) negligible use of fossil fuel energy (iii) negligible pollution of the environment and (iv) high use of labour. It was shown in Chapter 7 that traditional Chinese vegetable farming practices have already been successfully used in a number of widely different vegetable farming environments in Southeast Asia in the recent past. Furthermore, it was shown in Chapter 8 that while the current vegetable farming practices in the different case study areas involve a mixture of traditional Chinese and modern Western practices, the use of these modern Western practices has nowhere significantly increased the productivity of land over that achieved by the use of traditional Chinese practices. Moreover, the traditional Chinese practices carry with them a number of important, indeed critical, advantages, related to energy, pollution and labour.

In view of these facts it is concluded that traditional Chinese vegetable farming practices represent practical and highly desirable alternatives to modern Western agricultural technology in helping to raise the productivity of land in a number of widely different vegetable farming environments in Southeast Asia.

The main implication of this conclusion is that government agricultural departments in Southeast Asia should give consideration to actively promoting the use of traditional Chinese vegetable farming practices, as opposed to modern Western agricultural technology, for the production of fresh vegetables. Priority consideration should perhaps be given to vegetable farming areas where capital for buying fossil fuel based farm inputs is in short supply and where farm labour is in plentiful supply, i.e., in areas where farmers are relatively poor.

Two final points, of wider significance, may be made. Firstly, traditional Chinese vegetable farming practices may well be relevant to vegetable production in the tropics generally. For instance, recent research in Cap Vert, Senegal, in West Africa, undertaken by Baker (to be published), shows that Chinese agricultural extension workers from Taiwan and the People's Republic of China have had some success in introducing a mixture of traditional Chinese and modern Western vegetable farming practices into marketing gardening there. It may be speculated, though, that they might have had even greater success had they concentrated more on introducing traditional Chinese practices and less on modern Western practices, as the use of the latter has been constrained by problems encountered in chemical input supply and farm equipment maintenance since the Chinese departed in 1979. Secondly, traditional Chinese vegetable farming practices may well be relevant not only to the production of vegetables in the tropics generally but also to the production of other crops in the tropics, such as, root crops, grain legumes and possibly even cereals, particularly in areas where increasing the productivity of land is important. Clearly, there is scope for a great deal of research along both these lines of thought as, indeed, there is on most of the issues and ideas discussed in the main body of this thesis.

APPENDIX A

NAMES OF VEGETABLE CROPS GROWN IN THE CASE STUDY AREAS

Table A.1 relates the English names used in this study, together with other commonly used English names, to the Latin names of the vegetable crops grown in the different case study areas. The table also relates the English and Latin names to their local Chinese, Thai, Indonesian/Malaysian and Filipino names.

The purpose of the table is to facilitate cross reference between this study and other literature concerning vegetable farming in the countries where the case studies were carried out. In that literature, there is a great diversity of different English and local names used for the same vegetable crops. In this study, one common English name has been used throughout for each vegetable crop. This name can be related to other English, Latin or local names, which may be better known to the reader, by simply referring to the table.

In the compilation of the table, 7 literature sources have been used. Index numbers which represent particular sources have been placed against each name listed in the table, as follows:

1. Herklots (1972: 127-499)
2. Plucknett and Beemer (1981: 379-382)

3a Dahlen and Phillipps (1980: 5-45)

3b Dahlen and Phillipps (1981: 5-62)

4. Ng, Tan and Wikkramatileke (1966: 178)
5. Sritunya (1975: 100)
6. Oomen and Grubben (1977: 134-135)
7. Soriano and Bautista (1977: 2-5)

Sources 1 and 2 have been used for obtaining English and Latin names. Source 1 has, in addition, been used for Cantonese Chinese names and for some other local names. Sources 3a and 3b, with their clear colour illustrations, have also been used for Cantonese names. Source 4 has been used for Teochiu (Chiu Chau) Chinese names. Source 5 has been used for Thai names, source 6 for Indonesian/Malaysian names and source 7 for Filipino names. Sources 3a and 3b and source 7 have also been used occasionally to supplement the list of other English names.

The vegetables listed in the table represent only the more commonly grown vegetables in the case study areas. The list is by no means exhaustive and many less commonly grown vegetables have been omitted. Those listed have been broadly classified, according to the main parts of the plants used as food in South China and Southeast Asia, as follows:

(a) Leafy vegetables: (i) cabbages,
(ii) other leafy vegetables,

(b) Fruit vegetables: (i) beans and peas,
(ii) gourds,
(iii) other fruit vegetables,

(c) Bulb, root and tuber vegetables.

Table A.1. Names of vegetable crops grown in the case study areas.

(a) Leafy vegetables

(i) Cabbages

English, used in this Study	English, other common	Latin	Chinese, Cantonese	Chinese, Teochiu	Thai	Indonesian/ Malaysian	Filipino
Flowering white cabbage 1,2	Chinese flowering cabbage 3a	*Brassica chinensis* var. *parachinensis* 1,2	Paak ts'oi sum 1 Choi sum 3a	Chye sim 4	Pakkangtung 5		
Chinese white cabbage 1,2		*Brassica chinensis* 1	Paak ts'oi 1 Baak choi 3a	Peh chye 4		Petsai 6 Pak-choi 6	Pechay 7 Pak choi 7
Celery cabbage 1	Chinese cabbage 2 Pe-tsai 1,Wong bok 1 Peking or Tientsin cabbage 3a	*Brassica pekinensis* 1,2	Wong nga paak 1 Wong nga ts'oi 1 Wong nga baak 3a		Pakgadkaw 5	Pe-tsai 6	Petsai 7
Chinese kale 1,2		*Brassica alboglabra* 1,2	Kaai laan ts'oi 1 Gaai laan 3a	Kana chye 4	Kana 5		
Leaf mustard 1,2	Mustard cabbage 1 Chinese mustard 1 Mustard greens 2	*Brassica juncea* 1,2	Kaai ts'oi 1 Gaai choi 3a			Sesawi 6	Mustasa 7
Swatow mustard 1,2	Broad leaf mustard 1	*Brassica juncea* var. *rugosa* 1,2	Taai kaai ts'oi 1 Chiu chau taai kaai ts'oi 1 Daai gaai choi 3b		Pakgadkiawplee 5		
Cabbage 1	Head cabbage 2	*Brassica oleracea* var. *capitata* 1	Kom laam 1 Ye ts'oi 1 Yeh choi 3b		Kalamplee 5	Kubis 1,6	Repolyo 7
Kohlrabi 1,2		*Brassica oleracea* var. *gongylodes* 1	Kaai laan t'au 1 Gaai laan tau 3b				
Cauliflower 1,2		*Brassica oleracea* var. *botrytis* 1,2	Fa laam ts'oi 1 Ye ts'oi fa 1		Kalamdog 5		
Sprouting broccoli 1	Broccoli 7	*Brassica oleracea* var. *italica* 1	Yeung ye ts'oi fa 1 I taai lei kaai laan 1 Ts'ing fa ts'oi 1		Kalamdogsimuang 5		

Table A.1 Continued

(a) Leafy vegetables

(ii) Other leafy vegetables

English, used in this Study	English, other common	Latin	Chinese, Cantonese	Chinese, Teochiu	Thai	Indonesian/ Malaysian	Filipino
Chinese spinach 1,2	Amaranth 1	*Amaranthus gangeticus* 1,2	In ts'oi 1 Een choi 3a			Bayam puteh 1 Bayam merah 1 Bayam 6	
Lettuce 1,2		*Lactuca sativa* 1,2	Shaang ts'oi 1 Saang choi 3b	Pang chye 4	Pakgadhom 5		Letsugas 7
Celery 1,2		*Apium graveolens* 1,2	K'an ts'oi 1 Kunn choi 3b	Khng chye 4	Tang o 1 Kunchai 5	Selderi 1	
Water spinach 1,2	Swamp cabbage 1 Swamp morning glory 2 Water convulvulus 7	*Ipomoea aquatica* 1,2	Ung ts'oi 1 Ong choi 3b		Pakbungjeen 5	Kang kong 1 Kangkong 6	Cancong 1 Kangkong 7
Watercress 1,2		*Roripa nashturtium-aquaticum* 1,2	Sai yeung ts'oi 1 Sai yeung choi 3a			Selada air 6	
Spinach 1,2		*Spinacia oleracea* 1,2	Poh ts'oi 1				
Garland chrysanthemum 1,2		*Chrysanthemum coronarium* 1,2	T'ong ho 1 Tong ho 3b				
Chinese box thorn 1,2	Matrimony vine 3a	*Lycium chinense* 1	Kau kei 1 Gau gei choi 3a				
Coriander 1		*Coriandrum sativum* 1	Uen sai 1,3b	Yuen swee 4	Pakchee 5		
Sweet basil 1,2		*Ocimum basilicum* 1,2	Ue heung 1		Manglak euk 5	Selasseh puteh 1 Pokoh 1 Kemangi 1	
Chives 1,2		*Allium shoenoprasum* 1,2	Sai ts'ung 1 Siu heung ts'ung 1				
Chinese chives 1,2		*Allium tuberosum* 1,2	Kau ts'oi 1 Gau choi 3a				
Wild rice 1,2	Wild rice shoots 3b	*Zizania aquatica* 1,2	Kaau sun 1 Gaau sun 3b				

Table A.1 Continued

(b) Fruit Vegetables

(i) Beans and peas

English, used in this Study	English, other common	Latin	Chinese, Cantonese	Chinese, Teochiu	Thai	Indonesian/ Malaysian	Filipino
Yard-long bean 1,2	Asparagus bean 1 Chitterling bean 2	Vigna sinensis var. sequipedalis 1	Tau kok 1 Ch'eung kong tau 1 Dau kok 3a	Chye Tau 4	Too-a fuk yaou 1	Kachang perut ayam 1 Kachang panjang 6	Sitao 7
French bean 1,2	Kidney bean 1,2 Common haricot 1 Navy,string & snapbean 1	Phaseolus vulgaris 1,2	Pin tau 1 Sz kwai tau 1 Been dau 3a				Habichuelas 7
Lima bean 1,2		Phaseolus lunatus 1,2	Sai min tau 1 Loi tau 1				Patani 7
Mung bean 1,2	Green gram 1 Golden gram 1 Tientsin green bean 1	Phaseolus aureus 1,2	Luk tau 1		Too-a-kee-o 1	Kachang hijan 1	
Sugar pea 1,2	Snow pea 2 Sugar pea pod 3b	Pisum sativum var. saccharatum 1	Ho laan tau 1 Hoh laan dau 3				Chicharo 7

Table A.1 Continued

(b) Fruit vegetables

(ii) Gourds

English, used in this study	English, other common	Latin	Chinese, Cantonese	Chinese, Teochiu	Thai	Indonesian/ Malaysian	Filipino
Cucumber 1,2	Chinese green cucumber 1 Yellow cucumber 3b	*Cucumis sativus* 1	Tseng kwa 1 Wong kwa 1 Ts'eng gwa 3b Wong gwa 3b		Tangkwa 5		Pipino 7
Oriental pickling melon 1,2	Chinese white cucumber 1 White melon 3a	*Cucumis melo* var. *conomon* 1	Ts'it kwa 1 Uet kwa 1 Baak gwa 3a				
Wax gourd 1	Chinese preserving melon 1 White gourd 1,Winter melon 2 (Fuzzy melon 3a = hairy young fruit)	*Benincasa hispida* 1,2	Tung kwa 1 Dong gwa 3a (Mo kwa 1, Tsit kwa 1, Tseet gwa 3a = hairy young fruit)			Kundur 1	Kondol 7
Bottle gourd 1,2	Calabash 1 White flowered gourd 1,2	*Lagenaria siceraria* 1	(Mo kwa 1=hairy young fruit) Oo lo kwa 1 Oo lo gwa 3b				Upo 7
Winter squash 1,2	Squash 2 Pumpkin 1	*Cucurbita moschata* 1,2	Faan kwa 1 Naam kwa 1 Naam gwa 3b			Labu merah 6	
Angled loofah 1	Angled luffa 2 Luffa squash 2 Silk gourd 3a	*Luffa acutangula* 1,2	Sze kwa 1 Sze gwa 3a			Ketola sagi 1	Patolang Tagalog 7
Smooth loofah 1	Dish-cloth gourd 1 Vegetable sponge 1 Smooth luffa 2	*Luffa cylindrica* 1,2	Shui kwa 1			Ketola manis 1	Patola 7
Bitter cucumber 1,2	Balsam pear 1,2 Bitter melon 2 Bitter gourd 7	*Momordica charantia* 1	Fu kwa 1 Foo gwa 3a	Khor kway 4		Peria 1 Pepare 6	Ampalaya 1,7 Amargoso 7
Chayote 1	Buddha's hand gourd 2	*Sechium edule* 1,2	Fat shau kwa 1 Faat sau gwa 3a Hop jeung gwa 3a			Labu siam 6	Chayote 1 Sayote 7

Table A.1 Continued

(b) Fruit vegetables

(iii) Other fruit vegetables

English, used in this study	English, other common	Latin	Chinese, Cantonese	Chinese, Teochiu	Thai	Indonesian/ Malaysian	Filipino
Hot peppers 1	(i) Chili 1,2, Tabasco 1 (ii) Long cayenne pepper 1,2	(i) Capsicum frutescens 1,2 (ii) Capsicum annuum var. accuminatum 1,2	(i) Tse tin tsiu 1 (ii) Ngau kok tsiu 1 Tsim tuk laat tsiu 1 Laht jiu 3a		Prigsod 5		
Sweet peppers 1	Bell pepper 1,2 Green pepper 3b Pimento 1, Paprika 1	Capsicum annuum var. grossum 1,2	T'im tsiu 1 Tang lung tsiu 1 Ts'eng jiu 3b		Prigyak 5		
Eggplant 1,2	Brinjal 1 Aubergine 1 Melongene 1	Solanum melongena 1	Ai kwa 1 Ngaai gwa 3b	Kio 4		Terong 1,6	Talong 7
Tomato 1		Lycopersicon esculentum 1	Faan ke'e 1		Makuated 5		Kamatis 7
Okra 1,2	Lady's fingers 1	Hibiscus esculentus 1,2	Ch'aan k'e 1 Ts'au kw'ai 1		Kachieb grajee-ap morn 1	Kachang bendi 1 Sayur bendi 1 Kachang lender 1	
Sweet corn 1,2		Zea mays 1,2	Suk mai 1		Kawpoad 5		

Table A.1 Continued

(c) Bulb, root and tuber vegetables

English, used in this study	English, other common	Latin	Chinese, Cantonese	Chinese, Teochiu	Thai	Indonesian/ Malaysian	Filipino
Common onion 1	Bulb onion 1 Onion 2 (Spring onion 1= young plant)	Allium cepa 1,2	Yeung ts'ung tau 1	Chang 4			Sibuyas 7
Shallot 1,2	(Spring onion 1= young plant)	Allium cepa 1,2	Kon ts'ung tau 1 Yuk t'sung 1 Ts'ung tau 3a	Chang 4			Sibuyas Tagalog 7
Welsh onion 1,2	Japanese bunching onion 1 Green onion 2 (Spring onion 1= young plant)	Allium fistulosum 1,2	Taai ts'ung 1				
Garlic 1,2		Allium sativum 1,2	Suen t'au 1 Taai suen 1 Suen tau 3a				
Chinese radish 1,2	Oriental radish 1	Raphanus sativus var. longipinnatus 1,2	Loh paak 1 Loh baak 3a		Pakgadhua 5	Lobak 1	Labanos 7
Ginger 1,2		Zingiber officinale 1,2	Keung 1 Geung 3a		Khing 1	Haliya 1 Atjuga 1	
Carrot 1,2		Daucus carota subsp. sativus 1,2	Kam sun 1				
Potato 1	Irish potato 2 White potato 2	Solanum tuberosum 1,2	Shue tsai 1			Ubi 1	Patatas 7
Sweet potato 1,2		Ipomoea batatas 1,2	Faan shue 1,3a			Keladi 1 Ubi jalar 6	Camote 1,7
Yam bean 1,2		Pachyrrhizus erosus 1,2	Sha kot 1 Saa got 3a			Kachang sengkuang 1	Singkamas 7
Greater yam 1	Yam 2	Dioscorea alata 1,2	Taai shue 1		Man laud 1 Man taparb 1	Ubi kemali 1	
Taro 1,2	Cocoyam 1	Colocasia antiquorum var. esculenta 1	Oo t'au 1 Woo tau 3a		Peu-ak 1	Keladi 1 Tales 6	Gabi 1

APPENDIX B

ESTIMATION OF FERTILIZER APPLICATION RATES AND CROP YIELDS

During the course of the farmer interviews fertilizer application rates and crop yields were provided in either local, metric or mixed (metric/local) units as follows:-

(a) Canton: jin (gun)/mou; and kg/mou.

(b) Hong Kong: catties/dau chung; piculs/dau chung; kg/dau chung; catties/bed.

(c) Bangkok: kg/bed.

(d) Singapore: lb/bed; kg/bed; catties/bed; wheelbarrows/bed (organic fertilizers only).

(e) Philippines: l (litre)/bed and cans/bed (organic fertilizers only); kg/bed; t/ha.

In converting local units to t/ha, the following conversion rates have been used:

(a) Canton: 1 jin (gun) = 0.5 kg; 1 mou = one fifteenth ha = 0.0667 ha.

(b) Hong Kong: 1 catty = 0.6 kg; 1 picul = 100 catties = 60 kg; 1 dau chung = one fifteenth ha = 0.0667 ha; bed size varies between farms.

(c) Bangkok: bed size varies between farms.

(d) Singapore: 1 lb = 0.454 kg; 1 catty = 0.6 kg; 1 wheelbarrow = 20 kg of organic fertilizer (chicken manure); bed size varies between farms.

(e) Philippines: 1l (litre)/bed = 0.6 kg and 1 can = 19l = 11.4 kg of organic fertilizer (chicken manure and oil-seed cake), bed size varies between farms.

In all instances where fertilizer application rates and crop yields were provided on a per bed basis, the average size of bed on the farm concerned was estimated and the per hectare rate or yield was calculated accordingly for each farm. In making this calculation, half the area of footpath around each bed was added to the dimensions of the bed, i.e., bed size was calculated on a centre to centre basis, including one bed and one footpath in the gross area of one bed.

APPENDIX C

ESTIMATION OF LABOUR USE

The assumptions made and methodology followed, in estimating labour use on the vegetable farms visited, are given below. Data for the estimates were obtained from farmer interviews.

Assumptions

(a) Each family member working full-time on the farm has been considered as 1.0 person, full-time labour equivalent.

(b) Male and female labour has been considered as being the same, i.e., doing the same kinds and amounts of farm work.

(c) Each family member working part-time on the farm has been considered as 0.5 person, full-time labour equivalent.

(d) School age children, who occasionally do farm work during weekends and holidays, have been excluded from the estimates.

It is realized that these are very crude assumptions. However, from a practical point of view, they were the only assumptions that could be made, unless a long and detailed survey of labour use was to be carried out. Such a survey would have had to cover every farming operation on each farm, and time for such work was just not available to the writer.

Methodology

(a) The number of full-time labour equivalents on each farm has been summed.

(b) The labour used per farm figures for each farm have been divided by the vegetable area in hectares of each farm, in order to obtain estimates of labour used per hectare. The ranges and averages of labour used per hectare for the farms visited in each country are given in the relevant case study chapters.

(c) By dividing the labour used per hectare figures for each farm by the number of crops grown per year on each farm, estimates for the amount of labour used per hectare per crop have been obtained. The ranges and averages of labour used per hectare per crop for the farms visited in each country are given in the relevant case study chapters.

(d) In the few instances where the farms are mixed farms, i.e., producing both vegetables and livestock, approximate proportional adjustments have been made to farmers' estimates of labour used on these farms, in order to derive figures for the amounts of labour actually concerned with vegetable growing.

(e) In the special case of Canton, where the production brigade farms are mixed farms, labour use data was provided specifically for vegetable or all crops areas. Hence, no problem arose concerning how much of this labour was involved with livestock production, and no adjustments to labour use figures were necessary.

APPENDIX D

FARMER INTERVIEW FORMAT

BACKGROUND INFORMATION:

Farmer:

name, origin/race/dialect group, experience, family.

Farm:

location, village, district, province/state, country;

topography, natural drainage, soil types;

size (ha), cropped/vegetable area (ha), livestock numbers, tenure, access, seed and other input supply.

Labour:

full-time, part-time; family, hired.

Market:

location, distance, transport, channels (dealers, cooperative, government).

FARMING PRACTICES:

Planting and multiple cropping:

vegetable crops grown, crop durations;

intensity of cropping (number of crops grown per bed per year);

planting methods (direct sowing, transplanting);

interplanting (types, examples);

staggering of planting dates, diversified cropping;

rotations (examples, including fallows if any).

Land preparation:

field and bed layouts (terracing, levelling, bunding, raised bed dimensions);

implements (hand, animal drawn, mechanized);

cultivations (types, timing);

mulching materials (seed beds, field beds);

overhead protection of seed beds;

trellising (materials, crops).

Organic fertilizers:

materials, sources, preparation (composting, fermentation);

application (rate t/ha, timing, placement - basal or top dressings).

Chemical fertilizers:

types (N:P:K content), sources;

application (rate t/ha, timing, placement - basal or top dressings);

liming (application rate t/ha, timing).

Irrigation and drainage:

water supply (surface, underground);

water distribution (gravity flow, pumping, canals, pipelines);

water application (methods of watering, scheduling);

field drainage (raised beds, drains, outlets, pumping).

Crop protection:

weeds and weed control (hand methods, herbicides & frequency of spraying);

pests and pest control (cultural methods, insecticides & frequency of spraying);

diseases and disease control (cultural methods, fungicides & frequency of spraying).

Harvesting and packing:

methods, timing, washing vegetables, packing.

CROP YIELDS:

yields per crop (t/ha/crop);

annual yield (t/ha/year).

COMMENTS:

conversion factors (local units to metric units);

farmer's opinions;

general.

Date. Reference number.

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